# SOCIO-ECONOMIC AND DEMOGRAPHIC DETERMINANTS OF MATERNAL MORTALITY RISKS IN ZAMBIA


**BY**

**Pamela CHIRWA BANDA**
**(SN: 719881)**

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# Declaration

**I, Pamela Chirwa Banda, hereby declare that this thesis, except for references to other literature, which have been duly acknowledged, is the outcome of my own work, produced under supervision and it has neither in part or full been submitted anywhere for any degree or examination.**

**Pamela Chirwa Banda**

**September, 2016**

**Dedication**

To God Almighty for his faithfulness to see me through and to the memory of my late mum Enedy Nauluta Chirwa. Thank you so much for your unconditional love, untiring hard work, and sacrifices made during our trying moments and helping me to hope for the best in all circumstances. I know that words are superficial to express my love for you.

I also dedicate this thesis to my children Kondwani, Beejay and Antonette. This thesis is a sign for you that you will accomplish whatever you set your heart to; with God on your side nothing is impossible.

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## BIOGRAPHIC SKETCH

### Pamela Chirwa Banda

**Research Interest**

Pamela is interested in research, planning and policy making of laws and programs pertaining to good governance, health issues, poverty reduction, community mobilization, youth and gender development**.**

**Biographical Statement**

Pamela is a PhD research student working under the supervision of Professor Odimegwu Clifford. She received her B.A. in Mathematics Education and MA in Population studies from University of Zambia, and joined the Department of Population Studies at University of the Witwatersrand in 2013. Her main research interests are in maternal health and policy research, with a focus on addressing health policy questions for maternal health issues. She works for the Ministry of Education in Zambia as a Senior Education Officer.

She has distinct skills in research, policy analysis, monitoring and evaluation, qualitative and quantitative data collection and analysis, coordinating workshops/seminars, In-service trainings, preparing work plans/budgets/reports and use of computer software prevalent in the commercial sector. She has excellent communication, presentation and management skills. She has presented papers and chaired at several population conferences. She has published one paper from her research project and has one which has been accepted and three which are under review.

## PUBLICATIONS

### Published

1. Banda, P.C. (2015). Status of Maternal Mortality in Zambia: Use of Routine Data. *African Population Studies Journal, 25 (2*).
2. Banda, P.C., Odimegwu, C.O., Ntoimo, L.F., & Muchiri, E (2016).Women at Risk: Gender Inequality and Maternal Health. *Women & Health, DOI: 10.1080/03630242.2016.1170092*

### Under review

3. Odimegwu, C.O., De Wet, N., & Banda, P.C. Risky Sexual Behavior among Women in Africa: Does Economic Empowerment Matter? *African Journal of Aids Research.*
4. Odimegwu, C.O., Banda, P.C., Adedini, S.A., & Elwange, B.C. Regional Variations in Risk Factors of Pregnancy Related Deaths in Zambia. BMC Journal rejected; *AJRH resubmitted.*

### Conference Presentations

1. Living Arrangements and Nutritional Status of Under-Five children in Sub-Saharan Africa
   **Family Demography and Post-2015 Development Goals conference, 27th – 29th June, 2016**
2. Is Place of Residence an overlooked factor in exposure to High Risk Pregnancy?
   ***7th African Population Conference, 30th November – 4th December, 2015***
3. Use of Maternal Death Risk Factor Index to estimate Maternal Mortality in Zambia
   ***3rd Asian Population Association Conference, 27th – 31st July, 2015***
4. Socio-Economic and Demographic Determinants of Maternal Mortality in Zambia
   ***10th Population Association of Southern Africa Conference 8th -10th July, 2015***
5. Regional Variations of Pregnancy Related Deaths in Zambia
   ***6th Cross-Faculty Graduate Research Symposium, 29th -30th October 2014***
6. Estimation of Levels and Determinants of Maternal Mortality at Provincial Level: A Model Based Method: ***DPS Pop Studies Mini Conference, 21st November 2014***
7. Determinants of Maternal Mortality in Zambia: ***DPS@10 27-28th October, 2013***
8. Maternal Mortality in Zambia: Case of Kafue District 2005- 2009
   ***8th Population Association of Southern Africa (PASA) conference, 10-12 July 2013***

### Honors and Awards

1. Awaiting Examiners Report Grant – April, 2016
2. Post Graduate Merit Award – January-December 2015
3. Andrew Mellon Foundation Scholarship to attend World Social Sciences Forum 2015
4. 1st Position Humanities-6th Cross-Faculty Graduate Research Symposium, 2014
5. Post Graduate Completion Grant, December 2014

6. Post Graduate Merit Award – January-December 2014

## Professional Development

1. Reviewer PhD proposal-DPS- Wits University
2. Reviewer of two papers from-Journal of Population Research (JPOR)
3. Chair Person-7th WITS Postgraduate symposium (Science Section) March, 2016
4. Chair Person-7th African Population Conference (Absentee Fathers Section) December, 2015
5. Demography and Population Studies Writing Retreat: 7th to 11th September, 2015
6. Tutor- Health Demography-Department of Population Studies, WITS-2014
7. Health Sciences PhD Writing Retreat: 11th to 13th June 2014
8. UCT Summer Training Programme in Survey Data Analysis using STATA, 6th - 17th January 2014
9. Humanities Graduate Centre Academic Writing Retreat: 11th to 15th November, 2013.

### Research Experience

**2013-2016**: Socio-Economic and Demographic Determinants of Maternal Mortality Risks in Zambia.

**2011**: Maternal Mortality and Status of Health Services in Zambia: A case of Kafue District (MA thesis report)

**2010**: Examination Results Performance Analysis in selected schools of Lusaka Province, Zambia (MoE project)

**2003**: The impact of poverty on HIV/AIDS: A case study of Mutendere Compound Lusaka – Zambia (BA.Ed project)

## Education and Professional Qualifications:

**2013-2016** PhD student- Department of Demography and Population Studies

***University of the Witwatersrand, South Africa***

2014 Tutor Demography Department

***University of the Witwatersrand, South Africa***

**2011:** Diploma in ICT Education

***University of Zambia/Africa***

**2011:** Master of Arts in Population Studies

***University of Zambia***

**2011:** Certificate in Education for Sustainable Development

***Uppsala University, Sweden***

**2009:** Certificate in Monitoring and Evaluation Certificate Course

***University of Zambia***

**2007:** Certificate in Psychosocial Counseling

***Chainama Health College***

**2004:** Bachelor of Education in Mathematics

***University of Zambia***

## List of Published Papers

1. Banda, P.C. (2015). Status of Maternal Mortality in Zambia: Use of Routine Data. *African Population Studies Journal, 25 (2*).
2. Banda, P.C., Odimegwu, C.O., Ntoimo, L.F., & Muchiri, E (2016).Women at Risk: Gender Inequality and Maternal Health. *Women & Health, DOI: 10.1080/03630242.2016.1170092*

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**List of Acronyms**

| | |
|---|---|
| AIDS | Acquired Immune Deficiency Syndrome |
| ANC | Antenatal Care |
| CARMMA | Campaign on Accelerated Reduction of Maternal Mortality in Africa |
| CSO | Central Statistics Office |
| EMOC | Emergency Obstetric Care |
| HIV | Human Immunodeficiency Virus |
| HMIS | Health Management Information System |
| HRP | High Risk Pregnancy |
| ICC | Intra-class Correlation Coefficient |
| MDG | Millennium Development Goal |
| MDRFI | Maternal Death Risk Factor Index |
| MMR | Maternal Mortality Ratio |
| MOR | Median Odds Ratio |
| NHSP | National Health Strategic Plan |
| PCA | Principal Component Analysis |
| PCV | Proportional Change in Variance |
| PPC | Postpartum Care |
| PVC | Variance Partition Coefficient |
| RHCS | Reproductive Health Commodity Security |
| SDG | Sustainable Development Goal |
| TBA | Traditional Birth Attendants |
| TTI | Tetanus Injection |
| ZDHS | Zambia Demographic Health Survey |

## Chapter One – Introduction, Problem Statement and Literature Review

### 1.0 Background

Adverse reactions of pregnancy and childbirth remain the leading cause of mortality and disability for childbearing women in many low- and middle-income countries. Internationally, increased attention has been given to maternal health, concentrated on reducing maternal mortality. Maternal mortality is a representation of the state of public health and vulnerable to targeted health interventions, both preventive and curative (Garenne et al., 2014). The tragedy of not avoiding these preventable deaths resulted in 287 000 maternal deaths worldwide in 2010 (Merdad et al., 2013). Proportions of maternal mortality show a greater discrepancy between rich and poor nations than do any of the other commonly used public health indicators, including infant mortality rate, the indicator which is most often taken as the primary measure of comparative disadvantage (Shen & Williamson, 1999a).

According to Hogan and colleagues, more than half of all maternal deaths occur in Africa, and the maternal mortality ratio in sub-Saharan Africa is more than twice the global average (Hogan et al., 2010). For instance, the adult lifetime risk of maternal death for the year 2010 was 1 in 39 for sub-Saharan Africa and 1 in 160 for Southern Asia, whereas developed regions had a much lower lifetime risk of 1 in 3 800 (WHO et al., 2012).

Bettering maternal health and lowering maternal deaths have been key concerns of international summits and conferences since the late 1980s, including the Millennium Summit in 2000 (Alshishtawy 2008). Maternal death issues have been discussed where for instance, the fifth Millennium Development Goal (MDG 5) was agreed upon to improve maternal health through the reduction of MMR by 75% by the year 2015 (United Nations, 2010). Furthermore, the

Sustainable Development Goals have been set to reduce maternal mortality ratios to not more than 140/100 000 live births for each country by the year 2030.

However, despite notable international investment under the Safe Motherhood Initiative and strategies to achieve the fifth MDG, countries with higher levels of maternal mortality are facing challenges in an attempt to lower their mortality rates (Zureick-Brown et al. 2013). Data show that for many sub-Saharan African countries, it will be impossible to achieve the fifth Millennium Development Goal (MDG) of decreasing maternal mortality by three quarters between 1990 and 2015 (Merdad et al., 2013).

Although almost all cases of maternal death are avoidable, the severe socioeconomic deprivation that is prevalent in most countries is not conducive to preventing the causes of maternal deaths (Savadogo et al., 2014). This is as a result of high fertility and maternal mortality rates in the regions where the lifetime risk of maternal death in high-income countries is 1 in 3 300, compared to 1 in 41 in low-income countries (WHO et al., 2015).

For instance, Zambia's goal with regards to the MDG5 target of decreasing maternal mortality rates to 162 deaths per 100 000 live births has been challenging as maternal mortality levels have remained high, from 729 per 100 000 births in 2002 to 591 in 2007 and 483 maternal deaths per 100 000 live births in 2010 (CSO, 2012).

In the quest to lower maternal mortality, the Zambian government has updated its National Health Strategic Plan 2011-2015 (NHSP 2011-2015) and has advanced the Maternal New-born and Child Health roadmap for the period 2007-2014 by setting up health priorities with the following objectives and strategic directions:

- Decrease the MMR from the current 591 deaths per 100 000 live births to 159 deaths per 100 000 live births by 2015

- Expand the rate of rural households living within 5 km of the nearest health facility from 54.0 percent in 2004 to 70.0 percent by 2015
- Lower the population/doctor ratio from the current 17 589 to 10,000 by 2015
- Decrease the population/nurse ratio from the current 1 864 to 700 by 2015
- Downsize the incidence of malaria from 252 cases per 1 000 in 2008 to 75 in 2015
- Improve the percentage of deliveries assisted by skilled health personnel from 45 percent in 2008 to 65 percent by 2015 (Ministry of Health 2011)

**Figure 1.1 Zambia National Health Strategic Plan**

| Strategic Directions | |
|---|---|
| To provide cost-effective, quality and gender sensitive primary health care services to all as defined in the Basic Health Care Package | • Implementation of the comprehensive roadmap and plan for Maternal, Newborn and Child Health services<br>• Scale up and sustain high impact nutrition interventions including vitamin A supplementation, iron-folate supplements, iodations of salt, infant and young child feeding and management of malnutrition<br>• Implementation of the malaria prevention and control interventions including IRS, ITN distribution, Intermittent Preventive Therapy in Pregnancy (IPTP,) and prompt and effective treatment<br>• Implementation of High Quality Direct Observation Treatment Strategy and control of Multi-drug resistant with focus on high risk groups<br>• Expanded access to HIV/AIDS prevention services including Male Circumcision services; condom distribution, STI, Control, PMTCT and provision of safe blood<br>• Continued expansion of ART services for both adults and children and in both rural and urban areas.<br>• Strengthen key interventions such as school health and nutrition programmes, SAFE strategy, community Mass Drug Administration to address Neglected Tropical Diseases<br>• Promote a multi-sectoral approach to environmental health within the framework of the decentralization process<br>• Implement comprehensive Health Promotion/BCC strategies to strengthen Health Promotion and disease prevention and address the social determinants of health in the country<br>• Strengthen the preventive and promotive interventions to control the emerging and existing NCDs<br>• Create a desk for clinical care specialist for non communicable diseases |
| Maternal Newborn and Child Health roadmap for the period 2007-2014 | |
| Objectives | • Provide skilled attendance during pregnancy, childbirth, and the postnatal period, at all levels of the health care delivery system.<br>• Strengthen the capacity of Individuals, families, and communities to improve maternal, newborn and child health (MNCH). |

***Source: Zambia Health Strategic Plan 2011-2015 (NHSP 2011-2015)***

To further complement these policies, Safe Motherhood Week has been conducted since 2010 in order to accelerate the achievement of MDG5 and boost the Campaign on Accelerated Reduction

of Maternal Mortality (CARMMA) in Africa. To promote access and utilisation, user fees for all maternal and child health provisions have been abolished. To encourage the equitable supplies of these services, the Ministry of Health conducts the routine biannual child health week.

In the year 2010, the Ministry of Health, together with its partners, conducted a vigorous campaign to ensure a successful Safe Motherhood Week in 35 priority districts, reinforcing already existing strategies for preventing maternal deaths in Zambia. The target was to downsize the number of women dying from preventable adverse reactions during childbirth and improve survival among children below five years of age.

During the campaign, the government and its partners worked to promote access to services in the attempt to achieve safer pregnancy and delivery and reduce maternal mortality in the country. In its awareness campaign the country focused on reducing the three known delays, according to (Thaddeus & Maine, 1994), that continue to contribute to these preventable maternal deaths:

• Defer in decision making when seeking medical attention

• Defer in accessing a health facility

• Defer in receiving appropriate medical attention at a health facility.

Services provided at the health facilities included focused antenatal care, family planning, adolescent health, HIV/AIDS/STIs counselling and testing, under-one immunisation, Vitamin A, folic acid, ferrous sulphate supplementation, ITNs distribution and health promotion activities. Messages on the seven key family practices (early antenatal visits, essential new-born care, use of ITNs, breast feeding, immunisation, hand washing and birth preparedness), were disseminated by neighbourhood health workers, health promotion officers and local media practitioners.

The District Health Offices were encouraged to strengthen a three-pronged strategy for safe motherhood to accomplish their goals: a) all women to have access to contraception to avoid unintended pregnancies; b) all pregnant women to have access to skilled care at the time of birth; and c) all those with adverse reactions to have timely access to quality emergency obstetric care.

A Reproductive Health Commodity Security (RHCS) committee was formed in order to help in the facilitation of reproductive health and family planning commodities. The neighbourhood-based agent such as Safe Motherhood Action Groups was revamped so as to be used in the sensitisation of the importance of skilled birth delivery. In line with the framework of Family Planning strategies, Neighbourhood-based Distributors (CBDs) distribute family planning services in remote areas. Furthermore, in order to solve the unfair distribution of skilled health personnel, MOH implemented the Zambian Health Workers Retention Scheme (ZHWRS), aimed at attracting and retaining core health workers in the underserved rural and remote areas. Deserving health personnel are now receiving retention funds and other non-monetary incentives (Ministry of Health, 2011).

### 1.1 Problem statement

At national and international level, the requirement for dependable maternal death estimates has grown momentously since the adoption of the Millennium Development Goals. To enhance maternal health, policy makers must make challenging decisions about where to allocate scarce resources and how to set programme and policy priorities. To make such choices, policy makers and programme planners need accurate data on the level of and trends in maternal deaths in their country or region. Equally valuable is data on variations in the risk of maternal death between, for instance, remote and urban neighbourhoods, or between the wealthy and the poor in a country. Unfortunately, dependable and comparable data are scarce. Too often policies or

strategies are advanced despite a lack of data that determine which women are at highest risk of maternal death and inadequate knowledge of which actions are most likely to reduce the risk of such deaths.

Provinces in Zambia do not disaggregate data on maternal mortality. Various studies on maternal mortality conducted in Zambia (Ahmed et al., 1999; Banda et al., 2007; Hazemba & Siziya, 2009; Kilpatrick, Crabtree & Kemp, 2002), have provided estimates of maternal mortality at national level using direct death inquiry, and though this is useful for international comparisons, none of these methods are suitable for estimating maternal mortality in small geographical areas where safe motherhood programmes are often implemented. These studies have rarely included neighbourhood influence on maternal mortality risks. Moreover, no known study has attempted to use Demographic and Health Survey maternal health indicators to estimate maternal mortality by region in Zambia. Yet, analyses of differentials within small geographic areas provide a better understanding of the social context in which the risks are high for regional priority interventions. In addition, other researchers (Achia & Mageto, 2015; Stephenson & Elfstrom, 2012) have all posited that inclusion of neighbourhood level variables is helpful in understanding several maternal health outcomes.

Also, Zambia, like most developing countries, has no complete vital registration system with factual attribution of causes of mortality. Therefore, the methods used most commonly to evaluate maternal deaths are household surveys with direct death inquiry, indirect and direct sisterhood methods and reproductive age mortality surveys. However, none of these methods are appropriate for measuring maternal mortality in small districts where safe motherhood programmes are often implemented. Also, data from health facilities do not produce population-

based measurements of maternal mortality unless all women deliver in health facilities, all maternal deaths are correctly identified and all facilities report maternal deaths.

The proposed study relied on the discoveries of past studies by advancing the current knowledge beyond the understanding of maternal mortality factors at individual and neighbourhood level. This is an important factor because the aspects of a neighbourhood where a woman lives tend to adjust to individual-level circumstances. For instance, living in neighbourhoods with a high proportion of women delivering at a health facility or a neighbourhood where women prefer giving birth at home has an effect on individual circumstance during choice of place of delivery.

It is in this regard that this study sought to examine the influence of both individual and neighbourhood factors on maternal mortality risk. Furthermore, analysis using the mean Maternal Death Risk Factor Index (MDRFI) model, was used to estimate maternal mortality ratio and its differentials across the country's provinces which contribute to the national mortality ratio. The MDRFI can be very useful for countries like Zambia whose data on maternal mortality are not disaggregated by provinces, hence making it difficult to assess factors determining maternal mortality at such levels. Therefore, this method (mean MDRFI), can be utilised at district or any lower level to measure maternal risk factors as well as estimate maternal mortality ratio. The MDRFI model is much easier to use at any level and quicker to forecast interventions as well as prevent probable risks compared to the use of the sisterhood method.

Other models have not been used to estimate maternal mortality at lower levels, but the use of this model enriches the scope as it helps in highlighting regional and socioeconomic differentials in the maternal mortality burden and ranks regions according to their potential maternal mortality burdens. A provincial approach to problem solving may help, not only with attaining target improvements, but also in monitoring and evaluation of programmes (Bour and Bream, 2004).

## 1.2 Literature review

### 1.2.1 Global overview of maternal mortality

Despite the fact that some studies (Hill et al., 2007; WHO, 2009) have highlighted the slow progress in reducing maternal mortality, global reduction in maternal mortality with discrepancies across countries has been reported elsewhere (Zureick-Brown et al., 2013; Margaret C. Hogan et al., 2010). Global maternal deaths were reduced from 546 000 in 1990 to 287 000 in 2010 (Merdad et al., 2013). The authors also observed that more than ninety percent of these deaths occured in low-income countries.

According to Hill et al. (2007), most of these deaths are avoidable. Although reduction of maternal mortality is a challenge for most countries, some countries in Northern Africa, Asia and Latin America have shown that a reduction in maternal mortality is achievable. For instance, countries like Malaysia, Sri Lanka, Honduras, and Egypt have reduced their MMRs by more than fifty percent in seven to ten years, and Thailand has reduced its MMR by seventy five percent in eighteen years (Pathmanathan, 2003; Ronsmans & Graham, 2006a; State of the World's Mothers, 2013). No other public health issue shows such a poor-rich disparity between and within countries and regions as does maternal mortality (Ronsmans & Graham, 2006c). This discrepancy is noticeable when correlating the adult lifetime risk for maternal death between developing and developed nations, which is highest in Africa at 1 in 39 followed by Asia, 1 in 160, while developed regions had the lowest lifetime risk of 1 in 3800 (WHO et al., 2012).

It is globally recognised that the conditions contributing to a maternal death are sepsis, obstructed labour, post-partum haemorrhage (PPH), eclampsia, pre-eclampsia, and risky abortion (Ronsmans & Graham, 2006a). The author further clarifies that maternal death is

concentrated around the time of childbirth and during the period after a risky abortion, and post-partum haemorrhage accounts for nearly a quarter of all maternal deaths worldwide.

The research by Robinson & Wharrad (2000) using a database of 155 countries found that three variables could explain 87 percent of maternal deaths: lack of trained birth attendants, low gross national product (GNP), and low number of physicians per 1 000 populations. Researchers concluded that maternal deaths could be substantially reduced if a high percentage of births are attended by skilled health personnel, an aseptic birth environment is ensured, maternal or neonatal adverse reactions are identified, and transport services for childbearing women to higher level health centres are made available. This is only possible if women use modernized health services. However, there has been concern about a considerable number of women that do not use modernized healthcare services, which is one of the determining factors of poor health outcomes like maternal death.

Some studies in both low and high income countries recommend that prenatal care is a significant factor in improved maternal health outcomes (Gajate-Garrido, 2013) and that use of skilled health personnel at birth is imperative to reduce maternal mortality (Moyer et al., 2013; Prata et al., 2011).

Other studies conducted globally have found the socioeconomic environment to have a substantial effect on health risk behaviour, healthcare use and health outcomes (Ahnquist et al., 2012; Pickett & Pearl, 2001). In terms of facility use and health risk behaviour, antenatal care usage has been found to be one of the important factors linked to the reduction of maternal mortality (Cantwell et al., 2011). Research has also identified a series of individual and neighbourhood factors that can have an impact on utilisation of antenatal care by women. The individual-level factors mainly include low educational status, little decision-making power, and

lack of awareness of the need for routine care visits, especially in the absence of danger signs, whilst some of the neighbourhood factors affecting antenatal care usage include the geography of the neighbourhood, existence of a functioning health facility, distance to the referral health centre, and the presence of health personnel providing antenatal care (Chama & Koch, 2013; Sadiq et al., 2011; Worku et al., 2013; Glei, Goldman, & Rodríguez, 2003). Moreover, the study by Walraven et al. (2000) on maternal mortality in Gambia revealed that poor quality of Antenatal Care (ANC) services contributed to the maternal mortality ratio of 424 per 100 000 live births in the study period. Tuladhar & Dhakal (2012) also discovered in their study that maternal adverse reactions like anaemia and pregnancy-induced hypertension occurred more commonly in women without ANC. The rate of low birth weight and preterm babies was higher in women with inadequate or no ANC. Also, prenatal mortality proportion was similar in no ANC and inadequate ANC factions. However, maternal and prenatal outcomes were found to be exceptional in women who attended ANC occasionally.

It is probable that in several developing countries, health promotion at antenatal clinics is limited to educative health discussion and more static transmissions through wall posters. However, the usefulness of antenatal care for maternal care lies in its capacity for detection of preclinical or early morbid states in pregnant women and the opportunity for health awareness that it permits (Oyerinde et al., 2012).

Education has also been discovered as a key determinant of demand for health services. There are a number of explanations for these (Abor & Abekah-Nkrumah, 2014; Raghupathy, 1996).

Education is likely to complement female autonomy so that women can advance towards greater determination and capabilities to make independent choices regarding their own health, as well as that of their families. It is expected that knowledgeable women seek out quality health

services and have a higher competence in using healthcare information to attain better health (Regassa 2011) . This is in accord with research by Fletcher & Frisvold (2009) and Munsur et al. (2010) who found that more knowledgeable women are more likely to be appreciative of the gains of healthcare and as a result are more likely to use preventive healthcare services.

Interestingly, research has constantly recognized an inverse correlation between women's education level and maternal death in the developing world. Recent Chilean prospective studies have substantiated the finding that educational realization is a strong independent predictor of all-cause mortality and concurrently has a modulating effect on other factors (Koch et al., 2012).

Maternal mortality has also been found to be associated with women's status. A study by Shen & Williamson (1999b) on women's status and maternal mortality in developing countries found that women's position, as measured by factors such as level of education proportionate to men, age at birth and birth interval, is a strong predictor of maternal death.

Similarly, in Indonesia for instance, maternal mortality was found to be three to four times higher among women with lower economic status compared to those who were wealthy (Adegoke et al., 2013). In other studies, low education levels, poor households, high parity and low usage of maternal health services were associated with maternal death (Abe & Omo-Aghoja, 2008; Rajan et al., 2013; Sonneveldt et al., 2013). Also earlier studies have shown the emphasis on the significance of maternal education. Whitworth & Stephenson's (2002) study in India found that post primary maternal education has the advantage of weakening the effect of short birth interval because improved female autonomy and access to resources tend to remove the competition for resources that often characterise short birth interval.

Lewycka et al. (2013) also showed that, apart from the effect of maternal education on maternal mortality in Malawi, neighbourhood mobilisation through women's groups and volunteer peer

counsellor health education were methods used to improve maternal and child health outcomes in poor rural populations in Africa. Furthermore, the study by Iyengar et al. (2009) provided evidence that the socioeconomic effect of mortality is substantial among the residents of rural Rajastham in India and that the burden of poor pregnancy outcomes disproportionately affects the economically deprived.

The authors conclude that women who are young, very old, or of high parity are at greatest risk of dying if their pregnancies follow a short birth interval. According to Barate & Temmerman (2009), ensuring skilled birth attendance combined with emergency obstetric care when adverse reactions arise could eliminate 75 percent of maternal deaths.

Other researchers like Ekman et al., 2008; Lee et al., 2009; Ononokpono et al., 2013; Sagna & Sunil, 2012 had examined the effects of individual and neighbourhood level factors on the utilisation of maternal health services and pregnancy outcomes in Nigeria, Cambodia, Asia, Tanzanian, India, Pakistan and Uganda. The authors established a notable correlation between maternal death and a number of neighbourhood level variables (distance/ barrier to health centre, region, disease burden and skilled attendance). Studies conducted in those regions established that maternal health outcomes were influenced by factors that operate at individual level (i.e. age at birth, parity, household wealth, marital status, health status, media exposure and education) as well as those within the familial and neighbourhood contextual situation in which a woman lives. Other factors, like living in a deprived neighbourhood, have been associated with a wide range of poor health outcomes and utilization (Aremu et al., 2011; Mekonnen & Mekonnen, 2003; Vinikoor-Imler et al., 2011), though the effects appear independent of individual level socioeconomic aspects. This has been echoed in several deliberations of the need to consider not only individual attributes, but also aspects of the neighbourhood in which individuals live in

understanding the distribution of health and disease (Blakely & Woodward 2000; Diez Roux 2004). Neighbourhoods have materialized as a likely pertinent group because they clearly possess both social and environmental aspects which could possibly affect the health of residents.

According to Kondo, socioeconomic aspects that affect poverty stricken neighbourhoods such as wealth inequality, education and employment are the most persistent predictors of health disparities and fatality (Kondo 2012).

The area where people live affects their health and life outcomes, which means poverty-stricken people's health outcomes are especially determined by whether they live in an urban or remote locality (Ononokpono et al., 2013).Thus, the universal debate on maternal death is still on going. Despite various researches that have been conducted globally on maternal mortality, the topic still remains an issue for research and policy in the developing world.

### 1.2.2 Sub-Saharan Africa Review of Maternal Mortality

Demographic and public health literature shows that maternal mortality remains a disheartening challenge on the African continent. A number of studies have associated the high number of maternal deaths in sub Saharan countries with many factors. Factors such as fertility rate (Muldoon et al., 2010; Margaret C. Hogan et al., 2010; AbouZahr & Wardlaw 2001) (a proxy for reproductive behaviour), educational attainment of the female population (Alvarez et al., 2009; Hogan et al., 2010b; McTavish et al., 2010), an indicator of early life experiences, acquired knowledge and skills (Koch et al., 2012), access to adequate maternal health facilities and skilled personnel are all thought to be essential factors of maternal health (Adegoke, et al., 2012). Socio economic status and education have both been identified as possible significant factors of women's health in developing countries and the consequent reduction of maternal

morbidity and mortality (Koch et al., 2012). Furthermore, it has been suggested that abortion restrictions may contribute to advanced maternal mortality rates (Berer, 2002; Culwell et al., 2010; Shaw, 2010).

In a study by Garba & Umar (2013), which analysed the medical causes and determinants related to maternal mortality in Sokoto, Northern Nigeria using verbal autopsy, found lack of seeking antenatal care (unbooked) and the three delays to be significant determinants of maternal mortality. Haemorrhage was found to be the leading cause of maternal death followed by postpartum haemorrhage. The authors, in addition, observed that neighbourhood enlightenment on the need for mothers to avail themselves of antenatal care and hospital deliveries have a significant effect on the reduction of preventable causes of maternal deaths. This is important because neighbourhood factors have been found to be associated with antenatal care visits and proved to act as moderators of the relationship between individual aspects and antenatal care visits (Ononokpono et al., 2013).

Access to Skilled Birth Attendance during childbirth and in the immediate postnatal period and Emergency Obstetric Care (EmOC) in case of obstetric adverse reactions are considered to be adequate strategies to lower the number of universal maternal and infant mortality (Scott & Ronsmans, 2009). (Li & Chuang, 2009) opined that elevated trends in the rate of pregnant women who delivered at health facilities or who made antenatal visits and who were systematically managed were highly associated with the declining trend in MMR that was also observed at regional level. The proportion of births reported to be assisted by skilled health personnel varies widely between countries, ranging from 40 percent to 69 percent (Adegoke et al., 2012).

In 2008, 66 percent of all births globally were attended by a skilled birth attendant, however, the proportion was low in sub-Saharan Africa (48 percent) compared to 65 percent, 93 percent and 99 percent in Asia, the region of the Americas and Europe respectively (WHO, 2008). For instance, in Zambia, the doctor population ratios stood at 1 to 15 000 in 2008 and in 2011 the unequal distribution was reflected in the provincial distribution of personnel indicating a skewed staff distribution in favour of urbanised provinces, for instance Lusaka's doctor: population ratio was 1: 6 247 compared to Northern Province's ratio of 1: 65 763. Whether at provincial or national level, this is far from the WHO-recommended doctor population ratio of one doctor to 5 000 and a nurse to population ratio of 700 (Ferrinho et al., 2011; Makasa, 2009). Risky abortions have also been found to account for most maternal deaths and contribute to significant morbidity among women, especially in poverty-stricken localities. According to the World Health Organisation, of all maternal deaths, those related to risky abortion are the most extremely underrated and yet at the same time they are those which are the most preventable (WHO, 2007).

Every year, globally, about 42 million women with unplanned pregnancies prefer abortion, and nearly half of these methods, are perilous. Some 68 000 women die of complicated abortion annually, making it one of the leading causes of maternal death (13 percent), and of the women who survive risky abortion, 5 million suffer long-term health complications (Haddad & Nour, 2009). In countries where abortion is restricted, women have to resort to illicit means to have an unwanted pregnancy terminated. As a consequence, high rates of risky abortion are seen, such as in sub-Saharan Africa, where risky abortion occurs at the rate of 18–39 per 1 000 women (Rasch 2011).

Lori & Starke (2012) also identified that haemorrhage was associated with high maternal mortality in Liberia. In their research in Uganda, Mbonye et al. (2008) added that non-availability of medical supplies, women with a history of abortions and stillbirths, parity of five and more and living 10 km far from the nearest health centre, caused maternal adverse reactions leading to death. Ikeako et al. (2014) also suggested that adverse reactions of induced abortion were responsible for nearly a third of all maternal deaths in Abakaliki, Southeast of Nigeria. Ujah et al.'s (2005) facility-based study in North Central Nigeria also contributed that maternal age, illiteracy, grand multiparity and non-utilisation of antenatal services, were risk factors for maternal mortality.

Different studies in South Africa attributed HIV/AIDS to be the leading cause of maternal death. For instance, Chopra's cohort study of HIV-positive women and their children recorded an elevated postpartum mortality rate of 2 265 per 100 000 in South Africa (Chopra, 2008).

In another Neighbourhood Survey of 2007, the South Africa Maternal Mortality Ratio (MMR) was estimated at 700\100 000 live births, 30 percent above the 2001 census. This high level occurred despite a low proportion of maternal deaths (4.3 percent) among deaths of women aged 15 to 49 years (Garenne et al., 2011). Also, using data from the 2001 census on external causes and maternal death led to estimates of 542/100 000 live births.

Taking the example of South Africa, a crucial question is whether the mortality increase was due to the deterioration in the quality of obstetric care or to the complicated reaction of looming diseases on pregnancy outcome. Garenne and colleagues addressed this issue. The authors stated that this level of maternal death was much higher than estimates predating the HIV/AIDS era. Furthermore, the authors established that indirect causes of maternal death appear more significant than direct obstetric causes. The MMR no longer appears to be a reliable measure of

the quality of obstetric care or a measure of Safe Motherhood (Garenne, et al., 2013; Garenne, et al., 2008).

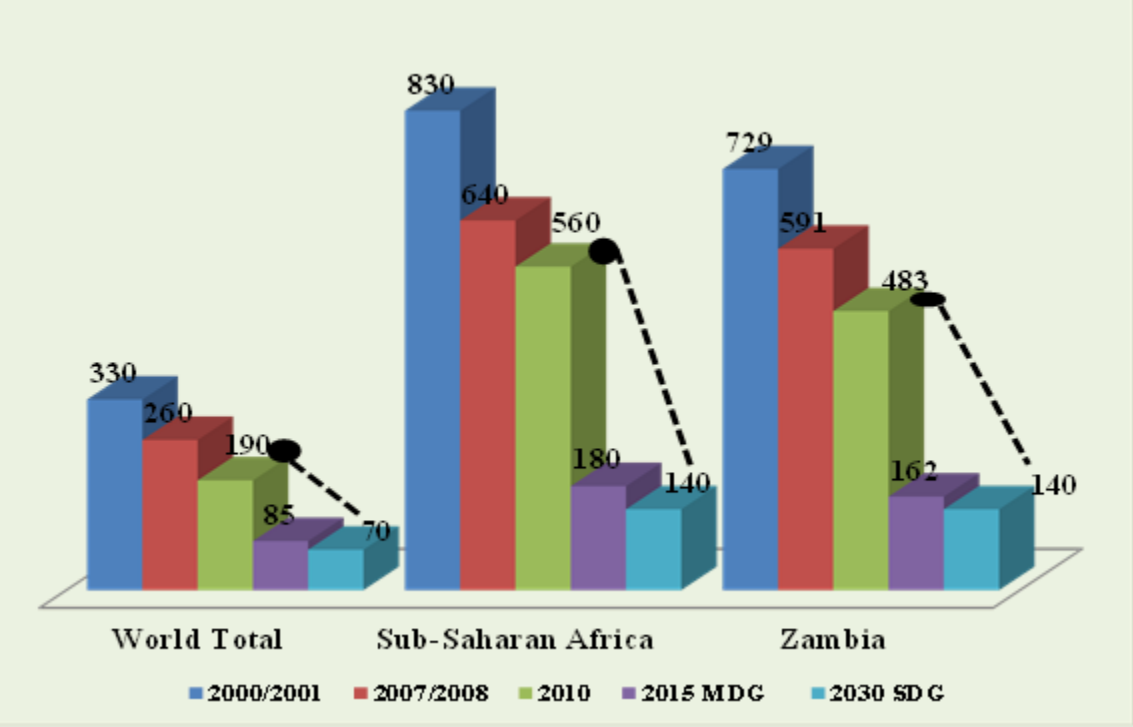
Another study by Ononokpono and colleagues on the investigation of neighbourhood factors related to the receipt of postnatal care in Nigeria, reviewed notable differentials in receiving postnatal care across neighbourhoods. The study precisely discovered that Nigerian women's probability of receiving postnatal care depended on where they resided (Ononokpono et al., 2013). Thus, the reviewed studies indeed highlighted a number of determinants related to maternal mortality in Africa. However, the proposed study relied on the premise established by past studies by advancing on the flaws identified in the studies. Thus, the proposed study goes beyond identifying individual-level factors of maternal mortality already established by past studies.

### 1.2.3 Overview of Maternal Mortality studies in Zambia

Although maternal mortality in Zambia has been decreasing, the decline is insufficient since Zambia has failed to meet the Millennium Development Goal target of 162.3 deaths per 100 000 live births. According to the Ministry of Health, on average 38 women die every month during pregnancy and childbirth (United Nations Development Programme (UNDP), 2013). The number of women dying during pregnancy and childbirth has decreased from 649 per 100 000 live births in 1996 to 483 in 2010 (Central Statistics Office, 2012). Now that the Sustainable Development Goals (SDGs), which will supersede the Millennium Development Goals (MDGs) when they expire this year are in the offing, Zambia, like any other country, has to work towards meeting the newly set targets. Global representatives have agreed on a global target for a maternal mortality ratio (MMR) of less than 70/100 000 live births by 2030 and less than 140 per 100 000 live births for individual countries (USAID, 2015; Bustreo et al., 2013). Without

concerted efforts Zambia will fail to reduce maternal deaths to warrant achievement of the sustainable development goal target (Figure 1).

**Figure 1.2: Estimated MMR globally and MDG/SDG for sub-Saharan Africa and Zambia (source: WHO, 2014; CSO, 2010)**




While several studies on maternal mortality in Zambia have established aspects at individual level that are significant predictors of maternal mortality, similar studies on the effects of community context have not been widely researched. Zambia, like many sub-Saharan countries, has high morbidity and mortality.

Zambia has sought to reduce maternal mortality by providing common access to reproductive health care services and basic and comprehensive emergency obstetric care. However, maternal mortality is entrenched in gender disparity, which manifests itself as poor education for girls, adolescent pregnancies and lack of access to sexual and reproductive health information and

services (Paruzzolo et al. 2010). This is related to the problem of risky abortions. Reports from the University Teaching Hospital reveal that nearly one in six of all maternal fatalities in Zambia are due to risky abortions, with young women specifically at risk (Coast & Murray 2014).

Zambia may have one of the most liberal abortion policies in sub-Saharan Africa, but there are many restrictions to accessing safe services, including stigma against abortions, even amongst healthcare providers. The republican constitution allows for the termination of pregnancies, provided such is done within the laid down conditions of the law. According to the Termination of Pregnancy Act of 1972, an abortion in Zambia can be conducted where the pregnancy constitutes a risk to the life of the pregnant woman. However, most women don't realize the procedure is legal and don't have the courage to go to a health center for a safe abortion because if the pregnancy is not life threatening they are afraid of being turned away by providers. Also the issue of getting permission from three physicians, as stated in the Zambian law, makes it almost impossible for most women. The result is that affected women go to great lengths to end pregnancies in secret (UNDP 2013).

Global evidence indicates that lifesaving health care services must be in place at the neighbourhood to health facilities in order to encourage women to utilize health services (Gabrysch et al., 2011; Koblinsky et al., 2012). Health centres must be adequately staffed by skilled birth attendants who can administer better services that boost neighbourhood trust in the health system. Neighbourhood mobilisation can drive the demand for health services, but as Klausner (2011) observes, this needs to be backed up by quality services that the 'customer' can trust. Too often women report poor quality service, even if a health worker is available. It has been found that only about a third of Zambian women delivered at a health facility in 2011, and

that distance and quality of care had a major impact on their uptake of services. The same research found that every step in increasing the quality of care led to 26 percent higher odds of a facility delivery (Gabrysch et al., 2011).

According to Stringer and colleagues, only a minority of pregnant women in the central town of Lusaka receive relevant diagnostic testing and treatment for the high-risk maternal conditions of, anaemia, malaria, and gestational hypertension (Stringer et al., 2013). It stands to reason that patients who do not expect health facilities to have skilled personnel, medicines, or tests may not make the often extraordinary efforts required to seek medical care. When healthcare providers are ill equipped to properly deliver essential health services, the experience contributes to a loss of trust in the healthcare system by patients. This loss of confidence may mean that patients delay seeking care, presenting with more acute, complex needs, which translates in turn to adverse clinical outcomes. These detrimental outcomes can, in turn, further erode trust in the system (Stringer et al., 2013).

Furthermore, sociocultural factors compound families' healthcare-seeking behaviour in such a way that many women delay travelling to health facilities and are not cautious of pregnancy adverse reactions. Knowledge about postnatal care is low. Infectious but avoidable illnesses contribute significantly to child death and illnesses, including malaria, respiratory infections, and diarrhoea diseases. All these factors have contributed to Zambia's high maternal, new-born, and childhood death indicators (Zambia Strategic Plan, 2011-2015).

The Government of the Republic of Zambia (GRZ) is committed to the promotion of maternal and child health. To boost access and utilisation, it has abolished user fees for all maternal and child health services. To promote the fair provision of these resources, cooperating partners have supported the Ministry of Health in conducting programmes like Child Health Week which

provides millions of mothers and children with access to immunisations, Vitamin A, distribution of free or low-cost insecticide-treated bed nets for prevention of malaria, and growth monitoring and promotion. Also, HIV counselling and testing, coupled with the provision of antiretroviral treatment, is supported by cooperating partners (MDGR, 2012).

The cooperating partners support the GRZ to promote safe motherhood and new-born health, and have provided the Ministry of Health with the procurement and distribution of antenatal cards in all the districts, while health workers in six provinces (Western, Southern, Eastern, North-Western, Luapula and Northern), have been mentored on safe motherhood. Integrated Neighbourhood Case Management of Childhood Illnesses (ICCM), with the support of cooperating partners, has also introduced integrated neighbourhood case management of child illnesses in selected districts (WHO & Unicef 2012). To date, over 1 209 neighbourhood health workers have been trained. District teams have also been trained in emergency obstetric and new-born care (EmONC) and Safe Motherhood Action Groups have been established, trained, and provided with basic supplies.

In Zambia, where key health indicators are below par with estimated maternal deaths above 2500 annually, the average neonatal mortality rate is 30 deaths per 1 000 live births and the average skilled birth attendance (SBA) rate has remained at around 47 percent for over 20 years (MAMaZ 2013). Wide urban to rural disparity in SBA rates of 83 percent to 31 percent (Central Statistics Office 2009), implies the need to focus efforts to improve usage of skilled personnel at birth in rural populations. Rural populations in Zambia face diverse challenges, including: inherent poverty,, poor infrastructure and social problems such as alcohol and drug addiction and gender-based violence. In addition, a number of significant obstacles inhibit women from accessing maternal health services, especially around delivery time.

These include lack of affordability, long distance to health facilities, lack of proper roads and means of transport; financial constraints, and knowledge gaps surrounding critical danger signs Working with (MAMaZ), operating from 2010 to 2013 in six districts in rural Zambia, the programme aimed to address factors that affect access to maternal, new-born and child health (MNCH) services, in particular Emergency Obstetric Neonatal Care (EmONC), and to advance relevant home-based care for women who were pregnant or had recently delivered, as well as for their babies (Green et al., 2013). The programme worked through existing structures, and the change process was neighbourhood driven.

During the MAMaZ timeframe of 2 ½ years, utilization of skilled personnel at birth across the six districts increased from 43 percent to 70 percent; the proportion of first time visits in the 1st trimester increased from 47 percent to 71 percent; the proportion of those women who attended four or more antenatal care visits progressed from 30 percent to 43 percent; use of modern family planning methods increased from 21 percent to 33 percent and uptake of postnatal care within six days increased to 48 percent. The retention rate of volunteers was 95 percent (Ensor, et al., 2010).

In spite of these interventions, reduction of maternal mortality is a challenge and some studies in Zambia have documented the underlying factors influencing maternal deaths and health-seeking behaviour. In a research done in Nchelenge by Michelo (2010), it was discovered that aspects of traditional beliefs, personal experiences of mothers and the attitudes of neighbourhood members were invaluable in understanding determinants of home deliveries. Another study done in Kalabo by (Stekelenburg et al. 2004), found that rural people preferred the services of Trained Birth Attendants (TBA) because of distance and delayed attendance at health institutions. This shows why in 2007 only 31 percent of rural women had deliveries assisted by a skilled birth attendant,

in comparison to 83 percent of urban women (Central Statistics Office, 2009). A 1994 neighbourhood-based study in the Western Province of Zambia found that most maternal care and deliveries occurred in the neighbourhoods and not at health institutions (Koster-Oyekan, 1998). Another neighbourhood-based study on maternal mortality in Kalabo district revealed a maternal mortality ratio of 1 238 per 100 000 live births, which is much higher than the official 500, clearly indicating that maternal death in the rural neighbourhoods is very high (Vork et al., 1997).

This is of concern as the population of Zambia is still largely rural. Of the total population of 13 092 666 in 2010, 60.5 percent of the population resided in rural areas while 39.5 percent resided in urban areas (CSO, 2012). Gabrysch, Cousens, et al. (2011) recommended that creative plans could include advanced transportation links, telemedicine, maternity waiting dwellings and pairing a single midwife with assistant midwives.

While levels of antenatal care have increased in many parts of the worlds during the past decade, only 46 percent of women in low-income countries benefit from skilled care during childbirth. For Zambia, births attended by skilled personnel worsened significantly from 50.5 percent in 1992 to 43.4 percent in 2002, although it increased slightly to 47.5 percent in 2007. In 2009, there were 2 374 midwives in Zambia, showing a slight reduction compared to 2008 (2 400 midwives), which represents approximately one midwife per 1 240 women aged 15 to 49 years (MDGR, 2011). Moreover, the total number of doctors, nurses and midwives registered in Zambia was less than half the standard of 2.28 total skilled staff members per 1 000 population required for ensuring skilled attendance at delivery, indicating a critical shortage in the country (Gabrysch et al., 2011).

If the improvement in maternal outcomes since 1998 revealed by DHS are to be fully analysed, then factors other than improvements in skilled attendance delivery must be substantive contributors. There are a number of possibilities, all of which require further exploration. For instance, Northern Province has shown improvement in the use of maternal health services in both urban and rural areas. This may be because the region started from a low base and is catching up. Also, there has been substantial donor input, particularly by UNFPA, in this region, and indicators may reflect this investment. This indicates that if programmes are implemented at district or primary level, the results are fruitful because determining factors are easily known.

Other studies showed that maternal deaths occurred because of the "three delays": delay in consulting a medical practitioner; delay in starting off to the healthcare facility; and delay in being offered the required services, including referral to a higher-level facility (Anyangwe et al., 2006). Health system failures in terms of insufficient provision of important antenatal screening tests and interventions were identified as a major contributing factor to maternal death (Kyei et al., 2012; Levine, 2007). It was discovered during the 2001-2002 ZDHS that 56 percent of women delivered at home, and Lohela et al. (2012) established that the distance to health facility and the level of care given are essential determinants of facility delivery. Other factors include women who had HIV. A 1997 Ministry of Health study found that AIDS contributed to 12 percent of the indirect causes of maternal death. The DHS reported some improvement between 2001/2002 and 2007. Notably, HIV prevalence stopped rising with malaria prophylaxis amongst pregnant women also increasing substantially in recent years. However, the Zambia Millennium Development Goal report noted that HIV incidence (new infections) remains high throughout the country and is alarmingly on the rise among young people and consistently higher in women than in men. Moreover, the percentage of infections in the country was consistently about twice

as high in urban areas in comparison to rural areas, and higher than the country's prevalence rate of 14.3 (Millennium Development Goals Progress Report, Zambia, 2013).

Another study by Kilpatrick et al. (2002) conducted at two referral hospitals of Central Province in Zambia discovered that infection was the main cause of maternal death and that of all the deaths that occurred, 82 percent were deemed preventable and system failure was identified as the likely contributing factor. In the study done at the University Teaching Hospital, Zambia, puerperal sepsis was found to be the main cause of postpartum admission. This mirrors the increased role that sepsis plays in maternal mortality rates in Zambia and other developing countries (Chama et al., 2000; Lagro et al., 2003; Pagel et al., 2009). Although there is some evidence that surgical delivery is on the increase, obstetric adverse reactions treated at medical facilities still appear to be low. This is of concern since it implies that many adverse reactions go untreated, leading to maternal death and morbidity. Reducing maternal mortality will require a substantial increase in the provision of emergency obstetric care at public facilities. Other findings by Koster-Oyekan (1998) in the Western Province of Zambia revealed an extremely high induced abortion mortality rate per 100 000 live births.

### 1.3 Deficiencies in the existing literature

While these studies have documented the influence of various factors (like distance, home delivery, HIV in pregnancy, abortion and sepsis) as causes of maternal mortality in Zambia and other parts of the world, studies on maternal mortality in Zambia have however largely overlooked the influence of neighbourhood factors like the socioeconomic and cultural environment of women's health outcomes. These factors can represent a burden to women's health and are important in explaining maternal mortality risks. Additionally, no known study has attempted to use Demographic and Health Survey maternal health indicators to estimate

maternal mortality by region in Zambia. Yet, analyses of differentials within small geographic areas provide a better understanding of the social context in which the risks are high for regional priority interventions. A detailed assessment of choice of neighbourhood variables is found in Chapter 3.4.6.

### 1.4 The purpose statement

The purpose of this study was to analyse the socioeconomic and demographic determinants of maternal mortality risks with a focus on individual and neighbourhood factors. The study seeks to contribute to the understanding of the levels and differentials in the risks of maternal mortality by region. This study is a secondary analysis of existing data from Demographic and Health Surveys (DHS) and Health Management Information System (HMIS), based on women aged 15 to 49 who had a live birth in the five years preceding the 2007 Zambian Demographic and Health survey.

### 1.5 Research questions

This study answered four basic research questions:

1. What are the effects of socio-demographic factors at individual and neighbourhood level on maternal mortality in Zambia?
2. What are the pathways through which neighbourhood variables affect maternal mortality risk in Zambia?
3. Do neighbourhood factors have a stronger influence on maternal mortality risk than individual factors and to what extent do individual and neighbourhood factors account for differentials in provincial patterns of maternal mortality risk in Zambia?

## 1.6 Research objectives

### 1.6.1 General objective:

This study aimed at examining the influence of both individual and neighbourhood level aspects on maternal mortality in Zambia.

### 1.6.2 Specific objectives:

1. To estimate provincial levels of maternal mortality ratios using MDRFI and to compare the estimate of maternal mortality using survey and routine data.
2. To investigate the mechanism through which neighbourhood variables affect maternal mortality risks.
3. To examine whether neighbourhood factors have a stronger influence on maternal mortality risks than individual factors and to assess the extent of differentials in provincial patterns of maternal mortality risks in Zambia.

## 1.7 Definition of terms

- Maternal death is defined according to the tenth international classification of diseases as the death of a woman whilst pregnant or within 42 days of termination of pregnancy, irrespective of the cause, duration or site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.
- Pregnancy-related death is defined as the death of a woman during pregnancy or within one year of pregnancy termination regardless of the duration or site of the pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

- Maternal mortality ratio is defined as the number of women who die from a maternal death during a given time period per 100 000 live births.
- Lifetime risk of maternal death is defined as the probability of dying from a maternal cause during a woman's reproductive lifespan.
- Neighbourhood or community is defined as a group of people with diverse aspects, who are linked by social ties, reside in a specific locality, share common perspectives, and engage in joint action in geographical locations or settings.
- Reproductive status of women is defined as the measurement of women's birth pattern based on their age, parity and birth spacing.
- Women's health status is defined as being undernourished, having hypertension, anaemia and HIV risk exposure.
- High risk pregnancy is defined as having one or more of the following conditions present: A woman is aged 18 or below at the time of pregnancy with her latest birth (too young); a woman is aged 35 or above at the time of pregnancy with her newborn (too old); a woman already had more than two live births at the time of pregnancy with her new-born (too many); a woman gave birth to her new born within 24 months of last live birth (too soon).
- Access to obstetric service is defined as the presence of a medical doctor at delivery or birth by caesarean section.
- Use of health services is defined as the use of skilled attendance at delivery, received postpartum care (PPC) after delivery or attended four or more ANC visits or if two or more TTI were given during pregnancy.

## 1.8 Significance of the study

The desire to save life during and after pregnancy is shared not only by the women but also by policy makers, researchers, health workers, families and religious leaders. However, attempts to heighten women's wellbeing are obstructed by inadequate local information on which to base policies and programmes, as well as the lack of a comprehensive understanding of the breadth and complexity of factors that determine maternal health.

Recent developments in health geography and social epidemiology play a major role in the recognition of 'place' as a significant factor underpinning health inequalities, given the uneven geographic development of risks associated with place as well as access to health promoting resources (Cummins et al., 2007; Macintyre et al., 2002). We need to better understand how various aspects of the area of residence affect women's health independently and in combination with individual and household-level factors.

The rationale for considering the aspects of the neighbourhood/community where people live has been well recognized in the social sciences (Schaefer-McDaniel et al., 2010). Such an approach is consistent with the discussions on the potential causal connections between neighbourhood context and individual behavioural and health outcomes (see especially Collings, Collings et al., 2011; Ellen et al., 2001; Pickett & Pearl, 2001; Ivory et al., 2000; Ellen & Turner, 1997; Manski, 1993). Population inequalities in disease are not generally fully accounted for by any known combination of individual genetic and environmental risk factors; therefore, some of the unexplained differentials could be attributed to other unmeasured factors, which may operate at an aggregate level. It has been pointed out that ecological factors may be the most important determinants of the health and disease status of a population. There is evidence which suggests that neighbourhood socioeconomic status is associated with health, achievement, and

behavioural outcomes, even when the individual-level income and education are controlled (Pickett & Pearl, 2001; Sampson et al., 2002).

However, the role of neighbourhood aspects in determining maternal mortality risks has, until recently, been an under-researched area in Zambia. A few studies in Zambia that have attempted to study the effects of neighbourhood on maternal health outcomes have had many shortfalls. This was small-scale research carried out in small-sized rural neighbourhoods and neighbourhood aspects were never analysed. Hence their scope was small and applicability of their results on a large scale was limited (Le Bacq & Rietsema, 1997; Koster-Oyekan, 1998). These studies rarely included sufficient details on the various contextual dimensions of neighbourhoods and thus failed to assess how these often overlapping dimensions might shape individual health outcomes. Examining a broader range of neighbourhood factors would allow for testing for more theories, thus illuminating potential causal pathways which involve neighbourhood factors.

Detailing causal effects of neighbourhood contexts on health would have significant policy implications. Variations across neighbourhoods are not ‘natural’ but rather result from specific policies (or from the absence of policies). Neighbourhood contexts are eminently changeable and responsive to economic and social policy, broadly defined. Harnessing and influencing these changes so that they are beneficial to the health of residents could have enormous public health implications (Diez Roux 2007).

In spite of this knowledge on neighbourhood contexts on health, there is a general lack of comprehension of the channels that transfers community-level social and environmental conditions to individual instances of pregnancy adverse reactions. This poses a challenge for

setting priorities and developing appropriate public health programmes and strategies, especially for neighbourhood health interventions (Meng et al. 2013).

The study attempts to resolve these issues by utilising the survey data and by engaging a multilevel modelling technique to assess the independent/moderating effects of various neighbourhood aspects. Furthermore, most data on maternal mortality are collected and analysed at a global or national level. Data collection or analysis at a provincial level incorporating several districts, is lacking in Zambia. A regional approach to problem solving may help not only with attaining target improvements, but also in the monitoring and evaluation of programmes (Bour & Bream, 2004).

In view of this, this study makes a major contribution to the multiple sources of data to be used in examining maternal mortality in sub-Saharan Africa by use of the maternal death risk factor index model. The new method being proposed can help policy planners identify high risk areas, prioritise target settings and help in accelerating attainment of sustainable development goals. The model used in this study can be used to estimate the maternal mortality ratio when provided with information on the maternal health of the women. This new method is much easier to use at any level and quicker to forecast interventions as well as prevent probable risks. The model proposed here could serve as the basis for a new and better system of mortality estimation for populations with incomplete data. Additionally, there is insufficient information on the neighbourhood factors associated with exposure to maternal mortality risks in Zambia.

Therefore, this study has bridged that gap in that the use of the multilevel framework has demonstrated significant neighbourhood differentials in the exposure to maternal mortality risks. The use of multilevel analysis in this study has shown that personal and neighbourhood aspects are significant factors correlated with exposure to high risk pregnancy. The use of this model in

analysing maternal problems enriches the scope as it helps in highlighting regional and socioeconomic differentials in maternal mortality burden and ranks regions according to their potential maternal mortality burdens.

### 1.9 Structure of thesis

The thesis contains eight chapters. Chapter One introduces the study by providing the significance and direction of the study. The chapter begins with a brief background to the study, a description of the problem under investigation, review of relevant literature, the purpose of the study, the research questions and objectives guiding the study and definitions of key terms. The significance of the study and structure of the thesis follows. Chapter Two presents the theoretical and conceptual framework that the study adopted. The ecological theory, as explained by Ellen and colleagues is presented, followed by the conceptual frame for the determinants of maternal mortality risks. Lastly, the research hypotheses are presented. Chapter Three concentrates on the research methodology which includes the study population, sample design and variable identification, statistical analysis, data cleaning and ethical issues. Chapter Four presents the descriptive statistics on the respondents' profiles. Chapters Five and Six highlight the study results: firstly, the multivariate analysis of the use of the MDRFI model, followed by the use of multilevel logistic regression in the analysis of neighbourhood effects and mechanisms through which individual women can be exposed to high risk pregnancy. Chapter Seven highlights the five hypotheses tested in the study. Chapter Eight concludes with a discussion of the relevance of the study to demography, policy implications and directions for future research. The chapter concludes with the limitations of the study.

## CHAPTER TWO – Theoretical and Conceptual Models

### 2.0 Introduction

This chapter introduces the theoretical underpinning of the study. The theories grounding the study are based on Ellen and colleagues' neighbourhood theory.

### 2.1 Theory

The study uses the neighbourhood theory proposed by Ellen and colleagues (Ellen et al., 2001). The theory is based on how neighbourhood influences health outcomes through four pathways. The proposed pathways are: (i) neighbourhood institutions and resources; (ii) stresses in the physical environment; (iii) stresses in the social environment; and (iv) neighbourhood-based network and norms. Thus, this study draws on these theories to examine the relationship between neighbourhood context and individual behavioural determinants of maternal mortality risks in Zambia.

### 2.2 Neighbourhood Theory by Ellen et al.

**2.2.1 Neighbourhood institutions and resources:** Neighbourhoods clearly differ in their access to healthcare facilities. The number and quality of medical practitioners differ across neighbourhoods, as does the nature of the medical technology and facilities. Poorer and less organised neighbourhoods are typically at a disadvantage (Adler et al., 2012; Ross & Mirowsky 2001). Moreover, other aspects of neighbourhoods may also make it difficult to get to the doctor in the first place, such as poor and inadequate transportation or even high crime rates that can make people fearful of travel. The resources in a neighbourhood might also influence residents' overall level of health (as opposed to their ability to be treated when sick).

Physical stresses in the neighbourhood environment influence health through contagious diseases like tuberculosis, malaria-infected areas, proximity of polluting factories and toxic waste sites, which may increase people's chances of contracting serious illnesses. These threats are common in lower-income and minority-occupied neighbourhoods where people are exposed to higher concentrations of air-, water- and soil-borne pollutants (Ash & Fetter 2004; Macintyre et al., 2003). In many epidemiological studies, air pollutants have been linked to lower life expectancy, increased mortality risk, frequent hospital visits, poorer birth outcomes, and asthma (Almond et al., 2012; Shah & Balkhair 2011).

**2.2.2 Social stresses in the neighbourhood environment:** People's health status can be directly affected by the social conditions in a neighbourhood. Most obviously, exposure to crime and violence has been shown to increase stress, as has exposure to other social conditions such as noise. Stress may exacerbate hypertension and other stress-related disorders, and may also weaken the immune system and increase vulnerability to disease and disability (VanItallie, 2002; Wadhwa et al., 2011).

Neighbourhood-based social networks also contribute to women's health in that health can be influenced by the communal surroundings of neighbourhoods, that is, by aspects of social relationships among the locals, including the scope of collective trust and feelings of connectedness among neighbours. Locals who are very close in a neighbourhood may be more likely to work together to achieve common goals (e.g. cleaning the environment, healthy behaviours and good schools),, to share information (e.g., regarding childcare and other resources that affect health), and promote healthy behaviours (e.g. discouraging crime or other undesirable behaviours such as alcohol use among youths and pregnant women) (Sampson et al.,

2002), all of which can directly or indirectly influence health. Social networks may also determine the behaviours to which one is exposed. If someone's friend drinks alcohol or has multiple sex partners, that person has a greater chance of behaving in the same manner (Berkman et al. 2000).

Drawing from the neighbourhood theory by Ellen and colleagues, this study modifies the McCarthy and Maine model in analysing the determinants of maternal mortality risk. Figure 2.1 presents a framework for analyzing the determinants of High Risk Pregnancy (HRP). The figure is based on McCarthy and Maine's original concept for analyzing the determinants of maternal mortality, but in this case the framework is focused specifically on High Risk Pregnancy. The determining factors are divided into two major parts (distal and intermediate), that can lead to the overall outcome - HRP.

The framework outlines the socioeconomic and cultural environment of those risk factors that can lead to High Risk Pregnancy. The main premise of the framework is that pregnancy is a necessary precondition for a complication to occur (or an existing condition worsened by pregnancy) to cause high risk pregnancy that can lead to a maternal death. Using the modified concept of McCarthy and Maine, this study draws from the Ellen and colleagues' theory, which posits that socioeconomic, cultural, and environmental variables are indirect determinants of health outcomes whose effects are mediated by direct determinants referred to as the intermediate fertility variables (Ellen et al., 2001). This framework is therefore organised around Ellen and colleagues' (Ellen et al., 2001) and McCarthy and Maine's stages of maternal mortality/morbidity (McCarthy & Maine, 1992).

Closest to the event of high risk pregnancy are the outcomes that culminate in either disability or maternal death and pregnancy-related adverse reactions. These are directly influenced by five

sets of intermediate determinants: the health status of the woman; her reproductive status; her access to health supplies; her healthcare behaviour (including use of health services); and a set of unknown factors. The intermediate factors are in turn influenced by a set of distal determinants: women's status in family and neighbourhood; family status in neighbourhood; and neighbourhood's status (McCarthy & Maine, 1992). The distal factors influence the intermediate factors such as women's health, reproductive status, health behaviour and use of maternal health services. These factors form the background against which the pregnancy can be at high risk.

### 2.3 Relationships and mechanisms of intermediate determinants

**2.3.1 Health status**: The factors included here are nutritional status, infectious and parasitic diseases, chronic conditions, and prior history of obstetric adverse reactions. A woman's health status prior to and during a pregnancy affects her chances of developing and surviving a complication. For example, a woman with anaemia is more likely to die from obstetric haemorrhage (McCarthy and Maine, 1992).

**2.3.2 Reproductive status**: These include age, marital status, and parity; which can affect a woman's chances of pregnancy, developing a complication, and developing disability from childbirth or dying of a complication. For instance, age and parity are thought to have a 'J-shaped' relationship with maternal mortality high risks for very young women, older women, women with no children, and those with many children, but are lower for women in-between (Maine, 1981). Younger women are also more likely to develop certain conditions such as prolonged labour; develop obstetric fistula or die from obstructed labour (McCarthy and Maine, 1992).

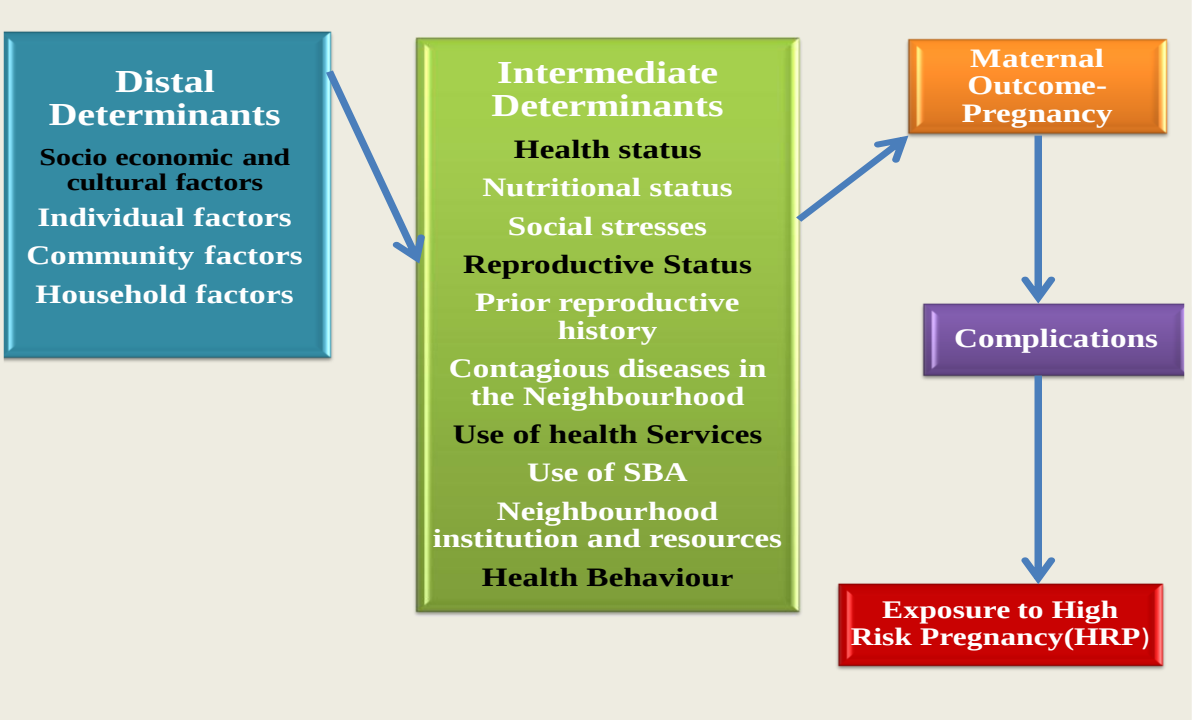
Access to health services: Poor access to health services increases the risk of poor outcomes. The services should include: services for women who want to avoid pregnancy (family planning and abortion services); those for women who want to have a safe and successful birth (antenatal, delivery, and postnatal care); and primary healthcare (McCarthy and Maine, 1992).

Healthcare behaviour/use of health services: Since availability does not ensure use, whether or not women use health services as well as other health-seeking behaviour directly affects their risk of maternal mortality or disability. The use of family planning services, antenatal, skilled delivery, and postnatal care is expected to reduce the risk of poor outcomes (McCarthy and Maine, 1992).

Unknown or unpredicted factors: This acknowledges that pregnancy adverse reactions can occur in women with no known risk factors and are unrelated to any of the identified determinants (McCarthy and Maine, 1992).

**2.3.3 Distal determinants**: The distal factors are related to the socioeconomic status (SES) of the woman, her family, and neighbourhood where she resides. Lower SES at any of the levels is predicted to increase the risk of poor outcomes indirectly through its effect on the intermediate determinants.

**Figure 2.1: Framework for analysing the determinants of High Risk Pregnancy (Adopted from McCarthy & Maine, 1992)**




## 2.4 Research hypotheses

The following hypotheses were tested in this study: using the following statistical analysis:

$H_{1:}$ Region of residence is a significant predictor of exposure to maternal mortality risks.

$H_{2:}$ Neighbourhoods with high proportions of deliveries attended by skilled health personnel are associated with lower odds of exposure to maternal mortality risks.

$H_{3:}$ A lower risk of exposure to high risk pregnancy is associated with residences and neighbourhoods that have a high proportion of women with post primary education.

$H_{4:}$ Neighbourhood factors are more significant predictors of exposure to high risk pregnancy than individual factors in Zambia.

$H_{5:}$ Women with low autonomy levels are associated with elevated risk of exposure to high risk pregnancy.

## Chapter Three - Data Sources and Methods

### 3.0 Methodology

This chapter presents the description of the study area and the rationale for selection, sources of data and data collection methods, sampling design, sample size, variables used in the study, data analysis and limitations of the study.

### 3.1 Study setting

Zambia is a landlocked sub-Saharan country in South Central Africa. It has a total surface area of 752 614 square km and shares boundaries with eight neighbouring countries, namely: Malawi, Mozambique, Zimbabwe, Botswana, Namibia, Angola, Democratic Republic of the Congo and Tanzania. Administratively, the country has been divided into ten provinces since the beginning of 2013, namely Central, Copper-belt, Eastern, Luapula, Lusaka, Muchinga, Northern, North Western, Southern and Western provinces which are further subdivided into districts (CSO, 2013).

The country's population in 2010 was 13 092 666, which increased from 9,885 591 in 2000 with the male population at 6.5 million representing 49.3 percent while that of the female population was 6.6 million, representing 50.7 percent of the total population. The population by province ranges from 2.20 million (16 percent) in Lusaka Province to 0.71 million (6 percent) in North Western. The country is sparsely populated with a density of 17.4 persons per square kilometre. Lusaka Province was the most densely populated province with 100.1 persons per square kilometre while North-Western Province was the least densely populated province with 5.8 persons per square kilometre (CSO, 2013).

The high population growth has been due to a number of factors such as high levels of total fertility rates (TFR) ranging from 7.2 in 1980 to 6.7 in 1990 and from 6.0 in 2000 to 6.2 in 2007 (CSO, 2009). Early marriages, desire for large families, low education levels particularly among females and lack of family planning among the illiterate.

The majority of Zambians live in rural areas though there has been a lot of rural-urban migration. In 2010, the population residing in the rural areas was 7.9 million (60.5 percent) while the urban population was 5.1 million (39.5 percent). There is a wide differential by province with Lusaka and Copper-belt provinces having the highest urban population and Northern and Eastern provinces the least. The population of Zambia continues to be termed as 'young' with a high proportion of persons (45 percent) below the age of 15 years. This holds the potential of a large proportion of young persons expected to enter the reproductive age (15 to 49 years).

### 3.2 Study design

This study used two secondary data sources, the 2007 Zambia Demographic and Health Survey (ZDHS), a nationally representative survey, and the 2011-2013 Zambia Health Management Health Information System. The ZDHS was conducted by Central Statistical Office (CSO), Ministry of Health (MOH), Tropical Diseases Research Centre (TDRC), and the Demography Department at the University of Zambia. The Measure DHS project collects standardised nationally representative survey data in many countries. The sample for ZDHS 2007 used a two-stage cluster sampling design with rural-urban and regions as strata. The sampling frame was obtained from the Census of Population and Housing of the Republic of Zambia (CPH) conducted in 2000, provided by the CSO. The frame consisted of 16 757 standard enumeration areas (SEA) created for the census. A SEA was a convenient geographical area with an average size of 130 households or 600 people, containing information about its location, the type of

residence, the number of households and the number of males and females in the population. All women of reproductive age who were either usual members of the selected households or who spent the night in the household before the survey were eligible for interview. The ZDHS is represented nationally, regionally and by urban-rural residence.

On the other hand, the HMIS was established by the Ministry of Health in 1996 and at the moment it covers all the health facilities that are found in all the 72 districts of Zambia. The HMIS currently captures data on disease morbidity and mortality, maternal and child health services and service delivery. HMIS data collection is conducted at health facility level using a paper based system and is aggregated and computerized from district to national level (Ministry of Health, 2007).

### 3.3 The population and sample

The nine provinces (using the 2007 DHS of Zambia) were divided into 18 sampling strata. Samples were selected independently in every stratum by a two-stage selection. A total of 7 408 women aged 15 to 49 years were identified in 7 326 households, out of which 7 146 (97 percent) were successfully interviewed (Central Statistical Office (CSO) et al., 2009). Women with no children and whose ages were either below 15 or above 49 were not included in the analysis. Therefore, 1 736 women were dropped and only 5 410 were included in the main working data set for the analysis. Weights were used to adjust for oversampling and under-sampling.

On the other hand, data from HMIS, which covers all the health facilities that are found in all the districts of Zambia, were collected for the period 2011 to 2013. The HMIS currently captures data on disease morbidity and mortality, maternal and child health services, service delivery, surveillance and financial services. HMIS data collection is conducted at the health facility level using a paper-based system and is aggregated and computerised from district to national level.

All data that is submitted from the health facilities to the national office follow an HMIS data flow guideline. The protocol was devised to detect and minimise the number of errors that may be captured at each level of service delivery starting from the health facility to national level (MOH, 2014). This implies that before data is assigned to the next level, it is authenticated and approved, making it more reliable for policy formulation, analysis and programme implementation.

### 3.4 Description of variables

The ZDHS variables for studying individual and household aspects was guided by the McCarthy & Maine conceptual framework for the determinants of maternal mortality, categorised as intermediate and distal determinants. The determinants are categorised as intermediate and distal determinants. Intermediate determinants are further categorised into three broader groups as reproductive status, health status, and the use of maternal health services. The distal factors are related to the socioeconomic status (SES) of the woman, her family, and neighbourhood where she resides. Lower SES at any of the levels is predicted to increase the risk of poor outcomes indirectly through its effect on the intermediate determinants.

#### 3.4.1 Distal determinants: Proximate Variables

Distal determinants are those related to the neighbourhood level; they include neighbourhood education level, neighbourhood HIV risk assessment, neighbourhood maternal education awareness, neighbourhood employment level, neighbourhood use of health facility at delivery, urban-rural and region of residence. The neighbourhood level variables of low, medium and high were generated by aggregating the individual variables. For detailed explanations on neighbourhood variables, see 3.4.6.

### 3.4.2 Health status

Women's health status that potentially put them at risk of maternal death was measured by the presence of under-nutrition, hypertension, anaemia and HIV infection. Women's nutritional status was assessed using Body Mass Index (BMI). The BMI is defined as an estimate of body composition that correlates an individual's weight and height to lean body mass, where elevated values can indicate excessive fat stores and low values can indicate reduced fat stores.

Abenhaim et al. (2007) and Denison et al. (2014) categorize BMI as follows:

- Underweight: less than or equal to a BMI of 19.9 kg/m2
- Normal: BMI of 20 – 24.9 kg/m2
- Overweight: BMI of 25 – 29.9 kg/m2
- Obese: BMI of 30 – 34.9 kg/m2
- Morbidly obese: BMI greater than 35 kg/m2.

Hypertension in pregnancy is defined according to (Duley 2009) as:

- systolic blood pressure of 140 mmHg or more
- diastolic blood pressure more than or equal to 90 mmHg.

Detecting a rise in blood pressure during the first hospital visit (> 30/15 mmHg), has in the past been considered useful in investigating preeclampsia in women who do not reach systolic blood pressure of 140 mmHg or diastolic blood pressure of 90 mmHg (Lowe et al., 2009). The above pressures were used to define hypertension in this study.

Anaemia for pregnant women is defined as Hb <110 g/L. The 110 g/L cut-off value is based on international convention (Brabin et al., 2001). The cut-off value was used to define anaemia in this study.

HIV risk assessment of survey respondents was measured using the DHS surveys.

### 3.4.3 Reproductive status

Reproductive status of the women is measured through women's fertility patterns based on their age, parity and birth spacing. It is important to consider the reproductive behaviour of a woman because the risk of pregnancy varies considerably from woman to woman, and because pregnancy estimates differ so greatly among different groups of women. Certain reproductive aspects like maternal age, marital status and number of previous births have all been previously shown to be associated with maternal mortality (Campbell & Graham, 2006; Ronsmans & Graham, 2006; Ronsmans & Khlat, 1999).

According to (McCarthy & Maine 1992), age and pregnancy order are known to have a classic 'J-shaped' relationship with the maternal mortality ratio, with risks that are high for teenage mothers, older mothers, first time mothers, and those with many children, but are lower for women in- between. For instance, the age of a pregnant woman affects her chances of exposure to risks of maternal death. This is due to a range of biological and social factors. Also, young women may be at increased risk of obstructed labour if their pelvises are not mature. Older women may have accumulated health problems like hypertension and diabetes which cause obstetric problems.

We use the term, fertility-related high risk pregnancy if one or more of the following conditions are present: A woman is below 19 years of age at the time of pregnancy with her most recent birth (too young); a woman is aged 35 and above with her most recent birth (too old); a woman already had three or more live births at the time of pregnancy with her most recent birth (too many); a woman gave birth to her most recent child within 24 months of a previous live birth (too soon).

### 3.4.4 Independent variables

The independent variables in this study include such important aspects at individual level, familial level and neighbourhood level. Fourteen variables included as intermediate determinants of maternal mortality were used (See Table 3.1). As presented in the conceptual framework, these determinants were categorised under: (1) reproductive status; (2) health status; (3) use of maternal health services; (4) indicator of access to obstetric service; and (5) availability of health services. Since our interest is in a negative outcome, we attach a value one (1) to any of the main categories; thus 1 to indicate poor reproductive status if one had two or more risks; for health status the value 1 was attached if BMI was $\geq 30$ and BMI $\leq 19.9$ or if exposure to HIV risk was high or if one had aborted before or if they had malaria. In the category of use of maternal health service, the value 1 was attached if the woman did not receive four or more ANC visits or if two or more TTI during pregnancy were not received or there was no skilled attendance at delivery or if the place of delivery was at home or if not received, postpartum care (PPC) after delivery.

For the category of indicator of access to obstetric service, the value 1 was attached if the woman had a vaginal delivery because the caesarean section rate within a coverage limit of 5 percent to 15 percent in a population is regarded as an indicator of access to obstetric care service as well as a medical doctor not being present at delivery if a complication arose. The last coding of 1 was assigned to availability of health services if the women indicated that distance to the health facility from their place of residence was far, which indicated that there was limited availability of health facilities within the area.

**Table 3.1: Individual variables used in the development of MDRFI (ZDHS, 2007)**

| SN | Determinant | Category of Determinants | Coding |
|---|---|---|---|
| 1 | Unsafe Pregnancy(two or more risks) | Reproductive Status | 0= No two risks: 1= two risks |
| 2 | Maternal nutritional status | Health Status | 0=BMI 20 to 29.9: 1=BMI≥30 and BMI≤19.9 |
| 3 | Exposure to HIV risk | Health Status | 0= Low risk : 1= high risk |
| 4 | Abortion | Health Status | 0= No : 1=yes |
| 5 | Malaria | Health Status | 0= yes protected: 1= No protection |
| 6 | Four or more Antenatal Care (ANC) | Use of Maternal health services | 0= received 4+ ANC: 1= Not received 4 ANC |
| 7 | Two or more TTI during pregnancy | Use of Maternal health services | 0= Received 2+ TTI: 1= Not received 2+ TTI |
| 8 | Skilled delivery at birth | Use of Maternal health services | 0= Yes: 1= No skilled delivery |
| 9 | Place of Delivery | Use of Maternal health services | 0= Health Facility: 1= Home |
| 10 | Receipt of Postpartum care (PPC) | Use of Maternal health services | 0= Received PPC: 1= Not received PPC |
| 11 | Contraceptive use | Use of Maternal health services | 0= Using modern contraceptives: 1=Not using |
| 12 | Caesarean section delivery | Obstetric care | 0= Yes: 1= No |
| 13 | Doctor present at delivery | Obstetric care | 0= Yes: 1= No |
| 14 | Distance to health facility | Availability of Health services | 0= No Problem: 1=Big problem |

### 3.4.5 Dependent variable

The outcome variable exposure to a high risk pregnancy outcome was developed by combining maternal age, parity and preceding birth interval. The three variables were chosen as composite descriptions of high risk pregnancy because research has found that pregnancy order is known to have a classic 'J-shaped' relationship with the maternal mortality ratio, with risks that are high for very young women, older women, women with no children, and those with many children, but are lower for women in-between (McCarthy & Maine 1992). Therefore, the outcome variable was defined as exposure to high risk pregnancy outcome if age was less than 19 years, or older than 35 years of age or parity of three or more and preceding birth interval less or equal to 24 months. The three variables are somehow interlinked as some studies have proved that certain reproductive aspects like maternal age and number of previous births have all been previously

shown to be associated with maternal mortality (Laopaiboon et al., 2014; Campbell & Graham, 2006; Ronsmans & Graham, 2006).

### 3.4.6 Neighbourhood variables

The neighbourhood variables were developed by aggregating the individual mother's aspects within their clusters using PCA. The aggregates were computed using the mean values of the proportions of women in each category of a given variable. The scores generated from the continuous index had a mean value of 0 and standard deviation of 1. The index allows for the categorisation of neighbourhoods into both least deprived and most deprived, based on socioeconomic aspects. Increasing scores are an indication of increasing neighbourhood disadvantage (i.e. a neighbourhood is most deprived if the scores are high).

There is insufficient information on the neighbourhood factors associated with exposure to maternal mortality risks in Zambia. Therefore, the following neighbourhood variables were selected based on past literature. These included: i) **neighbourhood maternal level of education**, defined as the percentage of mothers with post primary education in the primary sampling unit, and categorised as: low, middle, and high (cut-off at median value in all primary sampling units combined; 'middle' referring to the proportion at the median value, 'low' referring to the proportion below the median value, and 'high' referring to the proportion above the median value); ii) **neighbourhood use of health facility at delivery**, defined as the percentage of mothers who delivered their child at the health facility, and categorized as: low, middle, and high (cut-off at median value in all primary sampling units combined); iii) **neighbourhood maternal health awareness education** defined as the proportion of women in the neighbourhood with increased knowledge about maternal healthcare; iv) **neighbourhood HIV risk assessment** defined as proportion of mothers exposed to HIV risk; v) **neighbourhood**

**employment level** defined as the rate of women's employment in the area; vi) **area of residence** is defined as urban or rural; and vii) **women's region of residence**, categorised according to the nine geopolitical zones in Zambia, namely: Central, Copper-belt, Eastern, Luapula, Lusaka, Northern, North-Western, Southern and Western.

Neighbourhood hospital delivery was included because the proportion of mothers that delivered in a hospital setting serves as a prediction of how mothers in a particular neighbourhood responded to use of health facilities. Hospital delivery is one of the most important preventive measures against negative maternal and child health outcomes, and an important determinant of prevention of adverse birth outcomes in case of adverse reactions (Starrs, 2007). A woman's decision to use health facilities is strongly influenced by the behaviour of others in the neighbourhood (Stephenson et al., 2006); for instance, in a neighbourhood where a high proportion of women utilise a health facility for childbirth, the practice is hence likely to be seen as a norm, influencing individual behaviour. Given the demonstrated health benefits of institutional deliveries, it is necessary to understand the range of factors associated with the choice to seek professional care during delivery, and to understand the role that the neighbourhood has in influencing this decision. Neighbourhood mothers' education was assessed because higher levels of maternal education are associated with better maternal health outcomes (Karlsen et al., 2011).

Women's socioeconomic status was included because low socioeconomic status (e.g. education and income), has been associated with adverse pregnancy and birth outcomes (Luo et al., 2006). Place of residence, especially deprived areas like rural areas or provinces, was included because beyond individual socioeconomic status, neighbourhood poverty has been found to be associated with risk factors for poorer birth outcomes, increased unhealthy behaviour during pregnancy

(e.g. smoking during pregnancy) and lower utilisation of maternal health services (Daoud et al., 2015; Luo et al., 2006).

**Table 3.2: Neighbourhood Variables and coding (ZDHS, 2007)**

| SN | Variable | Coding |
|---|---|---|
| 1 | Community Education | |
| 2 | Community Poverty | Low |
| 3 | Employment Level | Medium |
| 4 | HIV risk Assessment | High |
| 5 | Awareness Maternal Educ. | |
| 6 | Place of Residence | |
| | | Urban |
| | | Rural |
| 7 | Place of delivery | |
| | | Home |
| | | Health facility |
| 8 | Region | |
| | | Central |
| | | Copper-belt |
| | | Eastern |
| | | Luapula |
| | | Lusaka |
| | | Northern |
| | | North-Western |
| | | Southern |
| | | Western |

### 3.5 Steps in data analysis

Data analysis involved the use of objectives in providing answers to the research questions. Therefore, each study objective was addressed as follows:

**3.5.1 First objective:** To estimate provincial levels of maternal mortality and complete a comparative estimate of maternal mortality risks using survey and routine data. This objective was addressed by developing the mean Maternal Death Risk Factor Index (MDRFI) based on 14 intermediate determinants from the Zambia Demographic and Health Survey individual women's maternal status. The model was developed in order to estimate maternal mortality by region and highlight regional and socioeconomic differentials in maternal mortality risks.

The intermediate factors encompass indicators of high risk pregnancy, lack of health services, poor health status, lack of obstetric care and non-use of maternal health services. Principal components analysis (PCA) was used to assign weights for each factor. The weighted sum of the factors yields a continuous variable that was labelled as a Maternal Death Risk Factor Index (MDRFI). This variable ranges from 0 to higher integer value. Zero value indicates the absence of any of the 14 intermediate risk determinants. Higher mean values imply the presence of the risk factors in excess. By implication, elevated MDRFI suggests elevated maternal mortality strain, while reduced MDRFI values suggest reduced maternal mortality strain.

The MDRFI can be very useful for countries like Zambia whose data on maternal mortality are not disaggregated by provinces, hence making it difficult to assess factors determining maternal mortality at such levels (UNFPA, 2012). Therefore, this method (mean MDRFI), can be utilised at district or any lower level to measure the maternal risk factors as well as estimate maternal mortality ratio. The MDRFI model is much easier to use at any level and quicker to forecast interventions as well as prevent probable risks compared to the use of the sisterhood method.

To estimate MMR for regions, a simple mathematical formula was used that established a correlation between the MRDFI and MMR. The following formula was generated showing a correlation between MDRFI and MMR.

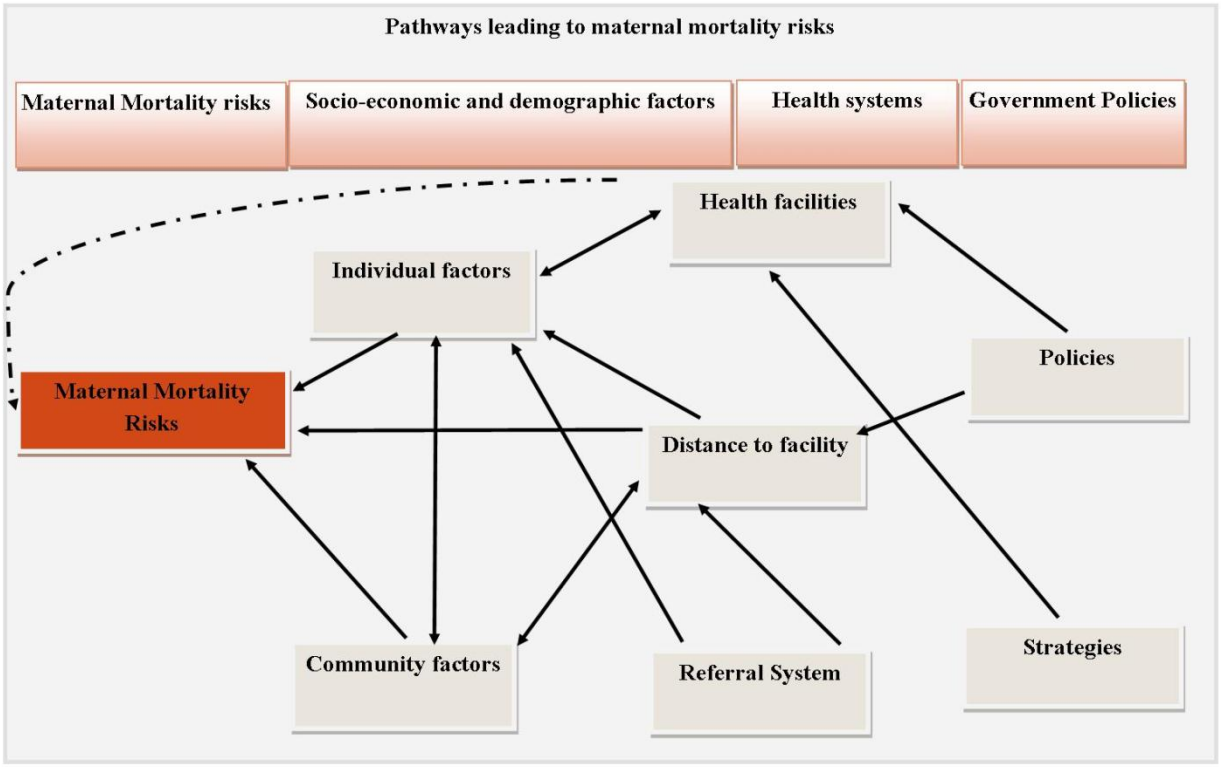
**Table 3.3 MDRFI Mathematical Formula to Predict MMR (adopted from UNFPA, 2012)**

| **Predicted $MMR_i$ =[$MDRFI_i$*AA]/BB<br>Where:** | |
|---|---|
| **CC** | Year of study |
| **$MMR_i$** | Denotes the predicted maternal mortality ratio for province I for CC |
| **Predicted $MMR_i$** | Denotes the maternal death risk factor index value for province i |
| **AA** | Reported maternal mortality ratio value (per 100 000) at the national level |
| **BB** | Average MDRFI value at the national level(based on estimates by the study) for CC |

This helped to assess whether the regions that have high maternal mortality risk factors using routine data are the same as those found using survey data. This gave a broader view of the national burden of maternal mortality.

**3.5.2 Second objective:** The multilevel logistic regression analysis was performed to investigate the mechanism through which contextual variables expose women to maternal mortality risks. Risks of maternal mortality are influenced by a range of multi-sectorial factors, including individual and neighbourhood factors, health systems and government policies. All of these factors have the potential of contributing towards adverse birth outcomes or reducing the risks of maternal mortality. These factors can be explained through the pathways to prevention of exposure to maternal mortality risks. The pathways framework allows one to conceptualise the interconnectedness of variables that affect high risk pregnancy and help us to identify risk factors and interventions at the different levels of the system, all of which affect high risk pregnancy**.**

**Figure 3.1: Pathway Framework for Maternal Mortality Risks**




*Modified from PRSP Sourcebook, Claeson et al.*

**3.5.3 Third objective:** To assess whether neighbourhood factors have a stronger influence on maternal mortality risks than individual factors and the extent to which individual and neighbourhood factors account for differentials in provincial patterns of maternal mortality in Zambia. To achieve this objective, the multilevel logistic regression analysis was done to examine the influence of contextual factors in explaining the geographical differential in maternal mortality risks across regions in Zambia. The cross-level interactions between individual factors, neighbourhood factors and maternal mortality risks were analysed. The analysis was done at bivariate and multivariate level in order to show how regional differential is built up from differential at various levels.

## 3.6 Statistical analysis

Analyses included univariate, bivariate and multivariate. The multivariate analysis for the different outcome indicators was performed using Multivariate Logistics Regression model. The mean MDRFI values were used to estimate maternal mortality for each province and assign maternal mortality load by province, urban-rural dwelling, women's educational status, and household wealth. STATA 12 was employed for data management and analyses.

### 3.6.1 Multilevel logistic regression model

Multilevel studies entail a hierarchical structure consisting of women (first level) nested within neighbourhoods (second level). Such study designs are subject to intra-class correlation, whereby individuals within groups are more alike than individuals across groups. This approach is regarded as a powerful and technically robust statistical technique with numerous strengths because it incorporates the use of regression models at more than one level of hierarchy (Blakely & Woodward, 2000). For instance: (i) the simultaneous examination of the effects of group level and individual level predictors is allowed, (ii) the non-independence of observations within groups is accounted for, (iii) groups or contexts are not treated as unrelated, but are seen as coming from a larger population of groups; and (iv) both the inter-individual and intergroup differential can be examined (as well as the contributions of individual-level and group-level variables to these differentials).

Thus, this study applied multilevel analysis techniques in order to account for the hierarchical nature of the DHS data and the binary response of the outcome variable (high risk pregnancy).

A two-level multilevel logistic regression model was applied in the study, consisting of two sub models at level 1 and level 2. This implies that individuals (level 1) were nested within neighbourhoods (level 2). The level 1 model represents the relationships among the individual-

level variables, while the level 2 model examines the influence of neighbourhood factors. For the bivariate and multivariate multilevel logistic regression analysis the STATA syntax xtmelogit was used (Duncan et al., 1998; Diez-Roux, 2000).

### 3.6.2 A two-level model for a linear outcome

In the level 1 model, the outcome $\mathbf{Y_{ij}}$ for women ***i*** nested within neighbourhood ***j;*** for example, in this study high risk pregnancy ($\mathbf{Y_{ij}}$**)** was a binary variable where the outcome is =1 if a woman ***i*** is exposed to risky pregnancy and =0 for not exposed to risky pregnancy (Cárdenas-Cárdenas et al., 2015b) . This can be expressed as follows:

#### 3.6.2.1 Ordinary logistic regression model

The ordinary logistic regression model can be written as this: $\mathbf{Y_{ij} = \pi i\ j + eij}$ **,**

$$\textbf{Logit } (\pi i\ j) = \log\left[\frac{\pi i\ j}{1-\pi i\ j}\right] = \alpha + \beta x i\ j \qquad (3.1)$$

$\mathbf{Y_{ij}}$ represents a binary outcome variable (exposed to high risk pregnancy or not at risk) and x is an individual-level explanatory variable. Where **i = 1, …, I j** is individual-level indicator**, j = 1, …, J** is the neighbourhood indictor. πi j is the probability of high risk pregnancy of a woman i in neighbourhood j, conditional on the risk factor x. This logit model has a linear function at the log odds scale.

The probability function is $\pi i\ j = \frac{\exp(\alpha + \beta x i\ j)}{1 + \exp(\alpha + \beta x i\ j)}$ (3.2)

This model is a one-level model without neighbourhood effects. It does not account for the differential between neighbourhoods and the nesting of women within neighbourhoods.

### 3.6.2.2 Multilevel logistic regression model

One approach, which take neighbourhood effects into account, treats the neighbourhood intercepts, **α j (j=1,..,J),** as a random variable with a specific probability distribution, which results in a random intercept model:

$$\textbf{Logit } (\pi i\ j) = \alpha j + \beta x i\ j \quad (3.3)$$

$$\alpha j = \alpha + uj \quad (3.4)$$

In this model, the neighbourhood effects were estimated by the random intercepts **αj (j=1,…J).** This was a linear combination of a grand mean **(α)** and a deviation (uj) from that mean. uj is independent of the woman level random error **(eij).** The neighbourhood intercepts measured the differences between the neighbourhoods, adjusting for other predictors in the model. Equation 3.3 is a multilevel model with two levels. The first level expressed the outcome as the total of an intercept for the neighbourhood to which the individual woman belongs and the woman's associated factors; the second level specified the neighbourhood level intercepts as the sum of an overall mean and the random deviation from that mean.

Substitution of equation (3.4) into equation (3.3) yields a combined model:

$$\textbf{Logit } (\pi i\ j\ ) = \alpha + uj + \beta x i\ j \quad (3.5)$$

The first model, which is referred to as the ''empty'' model, was fitted without explanatory variables. It only includes a random intercept and allowed us to detect the existence of a possible neighbourhood dimension for this phenomenon. The null model (model 1) enabled the estimation of the extent of differences in the outcome variable across neighbourhoods.

The second model (model 2) included only the individual-level factors. This is to investigate the extent to which area level differences of exposure to high risk pregnancy were explained by the individual composition of the areas. In model 3 only neighbourhood variables were

included in order to investigate whether the neighbourhood phenomenon was conditioned by specific area aspects. Model 4 included both the neighbourhood and individual variables. Thus model 4 investigated the attributes of the socioeconomic and demographic effect of the neighbourhood on exposure to high risk pregnancy and investigated the extent to which neighbourhood factors moderate the association between individual factors and maternal mortality risks. The final model (Model 5) was used to estimate whether neighbourhood factors moderated the association between individual-level variables and exposure to high risk pregnancy. This model included both individual and neighbourhood variables and a cross-level interaction between women's education and marital status.

The multilevel regression analysis accounted for the possible intra-neighbourhood correlation of the individual-level information. Accounting for this correlation is necessary in order to obtain correct statistical estimations of uncertainty (i.e. standard errors). Notably, the intra-neighbourhood correlation is a variance partition coefficient that indicates the share of the total individual variance that is at the neighbourhood level. The size of this coefficient is fundamental information in our study since the higher the coefficient is, the more relevant the neighbourhood level is for understanding a woman's exposure to high risk pregnancy (Griffiths et al., 2004). The ratio of the variance at the neighbourhood level to the total variance is referred to as the intra-class correlation coefficient (ICC).

The intra-class correlation is calculated as:

$$\rho = (\sigma 2\mu / (\sigma 2\mu + \pi 2/3))$$

Where: $\rho$ is the intra-class correlation (ICC), $\sigma 2\mu$ is the variance at the neighbourhood level $\frac{\pi 2}{3} = 3.29$ and represents the fixed individual variance (Snijders & Bosker, 1999).

However, variances at the two levels are on difference scales – the individual level is on the probability scale and the neighbourhood level is on the logistic scale. Therefore, ICCs calculated from MLR models may not accurately represent the partitioning of variance and they may also have issues pertaining to interpretation and generalisation (Goldstein et al., 2002). To provide a clearer interpretation of neighbourhood variance, we calculated MOR in addition to ICCs.

MOR is the median of a set of odds ratios that are obtained by comparing two mothers with identical individual-level aspects from two randomly chosen, different neighbourhoods (i.e. with different neighbourhood random effect). MOR is thus the median odds between a mother in the neighbourhood with higher risk pregnancy propensity and another mother in the neighbourhood with lower pregnancy risk propensity. The value of MOR is always equal to 1 or greater. If MOR is equal to 1, there are no differences between neighbourhoods. The greater the MOR than 1, the more the between-neighbourhood differential that is not explained by the modelled predicting variables (Merlo et al. 2006). In this study, the MOR shows the extent to which the individual probability of exposure to high risk pregnancy is determined by residential area and is therefore relevant for computing neighbourhood phenomena. The MOR is statistically independent of the outspread of the phenomenon, and can be simply calculated in the null model and in more detailed models. To easily understand the basis for the MOR, we assume that we consider all possible pairs of persons with identical covariates but residing in different areas. The MOR relies directly on the area level variance and can be calculated with the following formula:

$$\mathbf{MOR = exp[\sqrt{(2 \times \tau^2)} \times 0{:}6745] \approx exp(0.95\sqrt{\tau^2})}$$

where $\tau^2$ is the area-level variance, and 0.6745 is the $75^{th}$ centile of the cumulative distribution function of the normal distribution with mean 0 and variance 1. If the MOR is equal to one, in this case there would be no differentials between areas in the odds of exposure to high risk

pregnancy. If there were strong area-level differentials, the MOR would be bigger than 1 and the area of residence would be appropriate for comprehending differences of the individual probability of exposure to high risk pregnancy. The standard error of the area-level discrepancy indicates the precision of the estimate. One feature of interest of the MOR is that it is precisely proportionate with the ORs of individual or area variables.

### 3.6.2.3 Cross-level interaction

Interactions between individual and neighbourhood aspects were added to the models to test whether the neighbourhood characteristic effects on exposure to high risk pregnancy were modified by individual-level aspects (Merlo et al. 2005). An interaction is the incidence rate of an event in the presence of two or more risk factors, differing from the incidence rate expected to result from their individual effects. In multilevel models, we can explore the potential interactions among variables across levels. For instance, if we are interested in the effect of interaction between neighbourhood maternal education and marital status, the multilevel model can be used to estimate the interaction between them. The multilevel model is specified as follows:

$$\textbf{logit}(\pi ij) = \alpha j + \beta j\, xi\, j \qquad \textbf{(i)}$$

$$\alpha j = \alpha + \gamma zj + uj$$

$$\beta j = \beta + \theta zj$$

The slope in equation (i) can vary across neighbourhoods. $\beta j = \beta + \theta zj$ indicates that the slope coefficient is a linear combination of the average slope ( $\beta$ ) and the neighbourhood effect ( zj ). It generates a cross-level interaction term:

$$\text{logit}\ (\pi i\, j\ ) = \alpha + \gamma zj + uj + \beta xi\, j + \theta zj\, xi\, j$$

where θ is the parameter for the interaction term zj xi j. Equation (i) is a random intercept model with cross-level interaction (Dai et al., 2010).

### 3.7 Cleaning of data

In this study, the completeness and consistency of the data was cleaned before analysis by running frequency, cross-tabs, and sorting of the variables of interest using STATA 12. By running frequencies of variables, missing values, invalid values and outliers were identified. The other method used for checking the accuracy of the data in this study was by examining the minimum and maximum values of numeric variables. For example, the study population covered women who had at least one birth prior to the survey, aged 15 to 49. The main data set had 7 149 women from 319 clusters. Hence, women who had no children and whose ages were either below 15 or above 49, were not included in the analysis. In terms of HMIS, data was used as it was attained from HMIS because it is cleaned before being shared with the public.

The method used for checking the consistency of the data was by the drop command in STATA. Therefore, 1 736 women were dropped and only 5 410 were included in the main working data set for the analysis. As this study used several explanatory variables that might be correlated to each other, the presence of multicollinearity was checked among independent variables using Variance Inflation Factor (VIF) at cut-off point of 10. Variables having a VIF value of less than 10 indicated absence of multicollinearity.

### 3.8 Ethical issues

This study conducted a secondary analysis of existing data sets. Since the data is secondary, no names or relationship to any individual is expected to be associated with these results and

permission for use of survey data from Macro was granted. In order to access HMIS data, permission was arranged and granted by the Ministry of Health Headquarters, Zambia.

## Chapter Four- Profile of Respondents

### 4.0 Introduction

This chapter presents the distribution of the study population by selected demographic, socioeconomic and neighbourhood aspects as well as the patterns of exposure to high risk pregnancy in Zambia. Furthermore, the bivariate relationship between exposure to high risk pregnancy and the respondents' background aspects, was presented. Figures were used to show the percentage distribution of respondents according to selected individual and neighbourhood levels aspects as shown in table 4.1.

### 4.1 Description of study population by background attributes

Table 4.1 presents a descriptive analysis of the study population according to their socioeconomic and demographic aspects. In the sample 62.5 percent came from rural areas. More than 50 percent lived in poor or average households. The majority of the population was currently married (77 percent). A smaller proportion of women had either no education (12 percent) or had attained secondary/higher education (28 percent) whilst the majority had attained primary education (59 percent). In terms of age distribution, the majority of the sampled women were aged 19 to 34 (64 percent) whilst more than a quarter of them were aged 35 years or older (32 percent), and the youngest aged 15 to 18 (4 percent). About 46 percent of respondents were not working and more than half were assessed for being exposed to HIV risk (52 percent). About 48 percent of the respondents did not utilise skilled attendance at birth, and the distance to a health facility was considered a big problem by 44 percent of the respondents.

## Table 4.1 Description of study population by background characteristics, ZDHS, 2007

| Variables | Total No. | Percentage |
|---|---|---|
| **Place of Residence** | | |
| Urban | 2032 | 37.49 |
| Rural | 3388 | 62.51 |
| **Wealth index** | | |
| Poor | 2104 | 38.82 |
| Average | 1040 | 19.18 |
| Rich | 2276 | 41.99 |
| **Respondent's Age (years)** | | |
| 15-18 | 199 | 3.67 |
| 19-34 | 3490 | 64.39 |
| 35+ | 1731 | 31.95 |
| **Marital status** | | |
| Never married | 410 | 7.56 |
| Currently married | 4166 | 76.86 |
| Formerly married | 844 | 15.58 |
| **Respondent's Education** | | |
| No education | 674 | 12.43 |
| Primary | 3206 | 59.16 |
| Secondary/Higher | 1540 | 28.41 |
| **Birth Interval** | | |
| Greater or equal to 25 months (≥ 25 months) | 3627 | 67.05 |
| Less or equal to 24 months(≤2 24 months) | 787 | 17.87 |
| First Births | 826 | 15.08 |
| **Children less 5 years** | | |
| 1-2 | 4725 | 87.18 |
| 3+ | 695 | 12.82 |
| Total Children ever born | | |
| 1-2 | 1917 | 35.38 |
| 3+ | 3503 | 64.62 |
| **Employment Status** | | |
| Working | 2937 | 54.19 |
| Not working | 2483 | 45.81 |
| **HIV risk assessment** | | |
| No risk | 2540 | 47.79 |
| Risk | 2775 | 52.21 |
| **Place of delivery** | | |
| Health Centre | 2161 | 52.12 |
| Home | 2985 | 47.88 |
| **Skilled delivery at birth** | | |
| Yes | 1983 | 52.15 |
| No | 2163 | 47.81 |
| **Problem to get to Health facility** | | |
| No problem | 3035 | 56 |
| Problem | 2385 | 44 |

### 4.2 Description of sample population by exposure to high risk pregnancy (HRP)

This section presents the descriptive statistics of the sample population in relation to the dependent variable high risk pregnancy developed by use of variables (maternal age, birth interval, parity and children ever born). The analysis is restricted to women who had a live birth in the five years preceding the 2007 DHS survey.

Table 4.2 presents the distribution of respondents' aspects according to components of the dependent variable (high risk pregnancy). The median age was 30.7, indicating that more than 50 percent of the women in the sample were either above 30.7 years or below the age of 30.7 years. Younger maternal age (less than 19 years) at birth was reported at an average of 4 percent. The population average for closely-spaced pregnancy was reported at 18 percent, whilst women with high parity were reported at 65 percent and pregnancy and child birth among women aged 35 or older was reported at 32 percent. The mean number of children ever born was 3.9, indicating that half the sample of women had at least four children or more. The population average for women who had three or more children under five years old was reported at 65 percent.

**Table 4.2 Percentage distribution of women aged 15 to 49 years by high risk pregnancy (maternal age, birth interval, children ever born and children under five) ZDHS 2007**

| Variables | | Frequency | Percentage |
|---|---|---|---|
| **Respondent's Age** | | | |
| 15-18 | | 199 | 4 |
| 19-34 | | 3490 | 64 |
| 35+ | | 1731 | 32 |
| **mean Age** | 30.7 | | |
| | | | |
| **Birth Interval** | | | |
| >=25 months | | 3627 | 67 |
| <=24 months | | 967 | 18 |
| first birth | | 826 | 15 |
| | | | |
| **Children less than 5 years** | | | |
| 1-2 | | 4725 | 87 |
| 3+ | | 497 | 13 |
| **mean no. of children** | 1.4 | | |
| | | | |
| **Total children ever born** | | | |
| 1-2 | | 1917 | 35 |
| 3+ | | 3503 | 65 |
| **mean CEB** | 3.9 | | |

### 4.3: Neighbourhood aspects

At neighbourhood level the following variables were used: neighbourhood maternal level of education, neighbourhood poverty, type of place of residence, neighbourhood hospital delivery, neighbourhood HIV risk assessment, neighbourhood maternal education awareness and region of residence.

The percentage distribution of the study sample by neighbourhood aspects is presented in figure 4.1. A consideration of type of place of residence indicated that a predominantly high proportion of women (63 percent) were living in rural areas while 37 percent resided in urban areas.

Regional distribution as indicated in figure 4.2 indicated that the majority of women (17 percent, 15 percent, and 14 percent) were residents of Copper-belt, Eastern and Lusaka/Northern respectively. The lowest proportions were women who resided in North-Western (6 percent), Western (6 percent) and Central (8 percent). Also, 11 percent and 9 percent were women residing in Southern and Luapula provinces respectively. Results in Table 4.3 further revealed that about one in five women (26 percent) were residing in neighbourhoods with a low proportion of highest education level, while 39 percent were women residing in neighbourhoods with a high proportion of women's higher education level.

A consideration of neighbourhood poverty indicated that 27 percent of women resided in neighbourhoods with a high concentration of poor households while 35 percent resided in neighbourhoods with medium concentration of poor households. Only about one in four women assessed their HIV risk as low whilst more than three quarters assessed their exposure to HIV as high or medium. About two in five women resided in neighbourhoods where awareness of maternal education was high, the rest (more than fifty percent) lived in neighbourhoods where awareness of maternal education was either low or medium. Results further show that 41 percent of women who resided in neighbourhoods were women who delivered at home and more than three in five women resided in neighbourhoods where the employment level was either low or medium.

**Figure 4.1: Percentage distribution of neighbourhood type of residence, ZDHS, 2007**

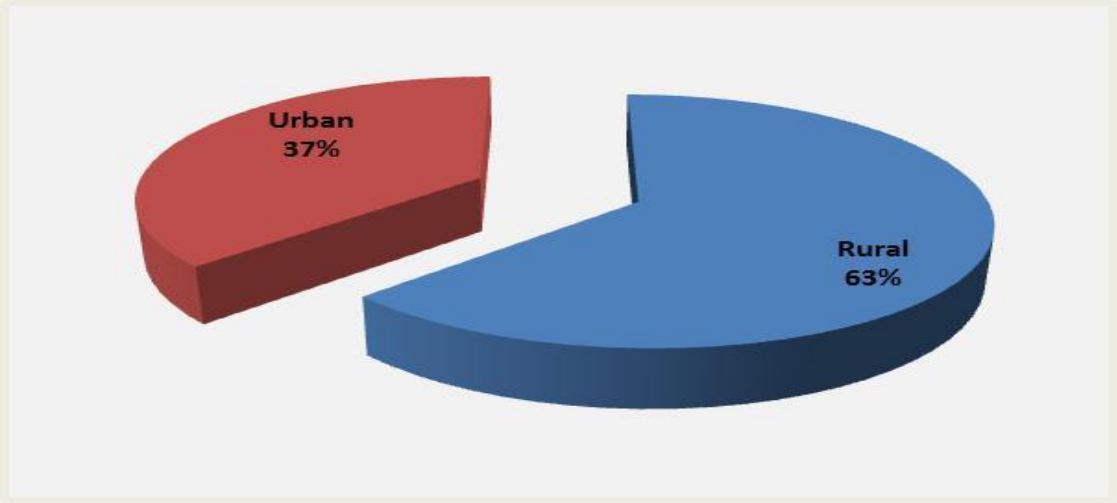



**Figure 4.2: Percentage Distribution of Neighbourhood Region of Residence, ZDHS, 2007.**

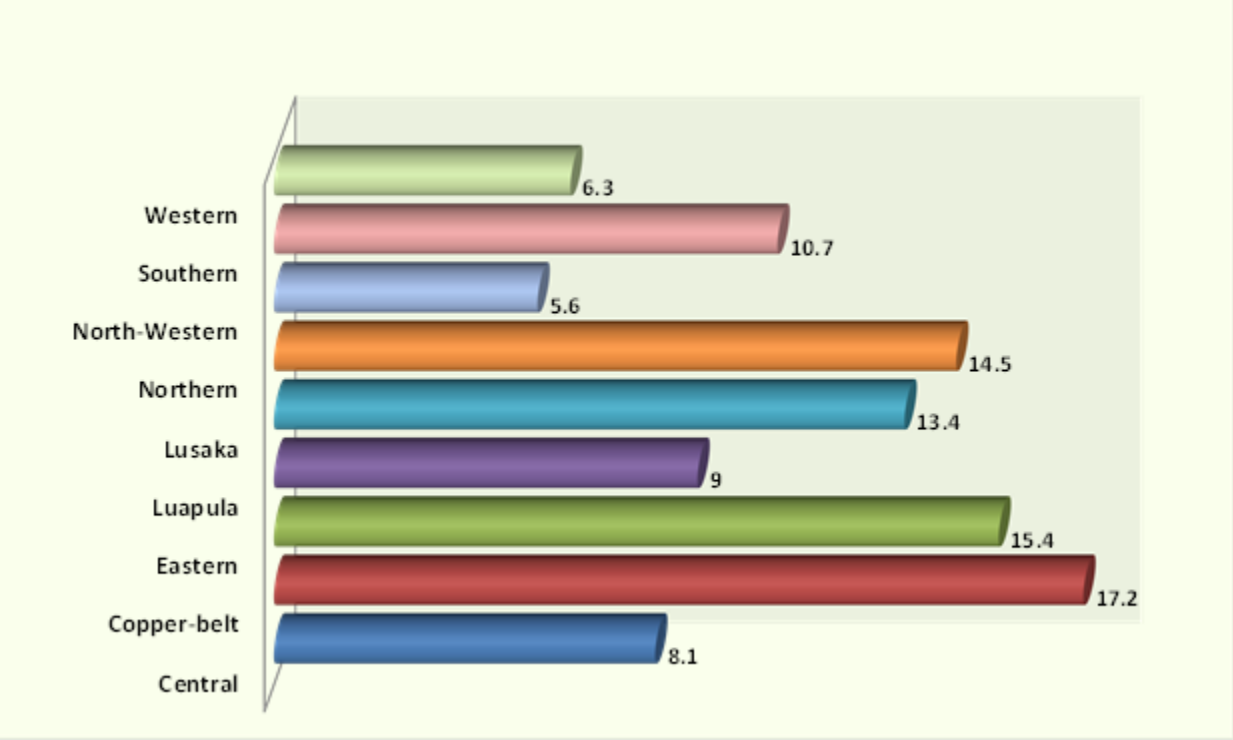


**Figure 4.3: Percentage distribution of neighbourhood attributes, ZDHS, 2007**

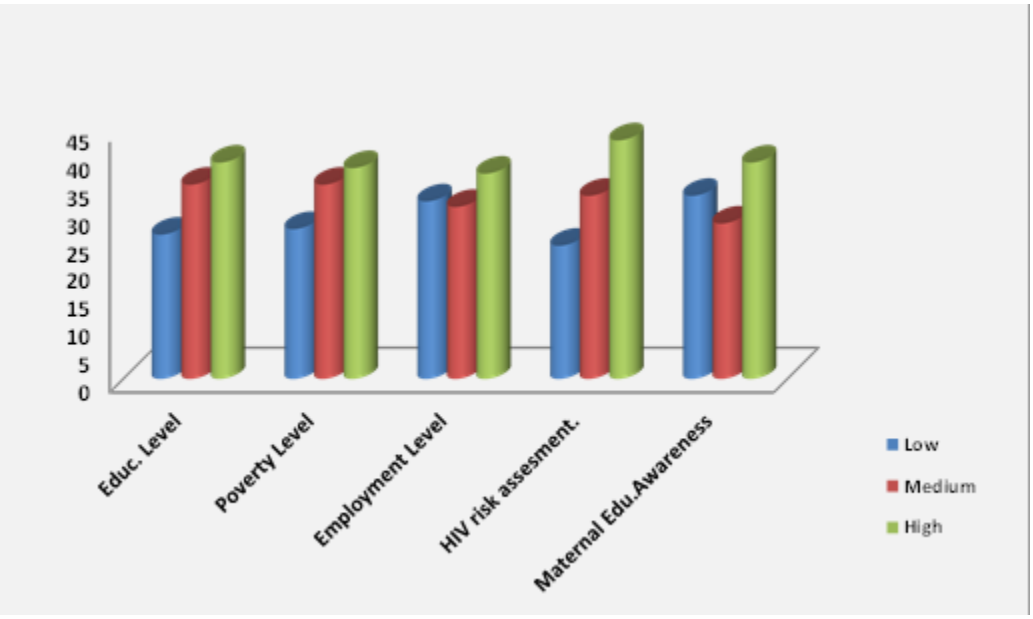
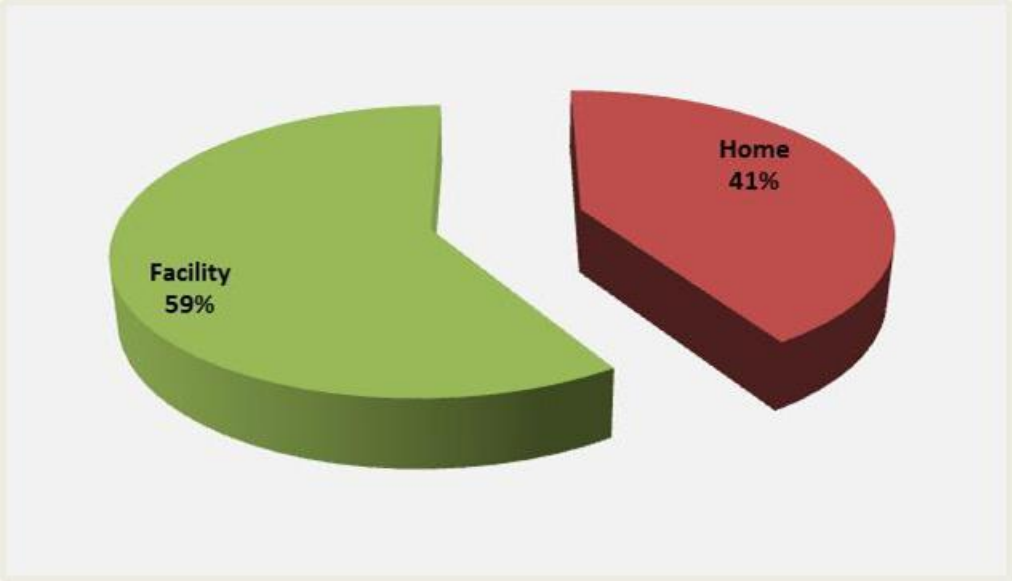



**Figure 4.4: Percentage distribution of neighbourhood place of delivery ZDHS, 2007**



### 4.4 Patterns of exposure to high risk pregnancy

This subsection presents the bivariate relationship between women's aspects and high risk pregnancy.

#### 4.4.1 Respondents' background aspects with exposure to high risk pregnancy

Tables 4.3 and 4.4 present the bivariate association between selected individual and neighbourhood aspects and exposure to high risk pregnancy. The proportion of women who were exposed to high risk pregnancy was very high (above sixty five percent in all provinces). The highest percentage of exposure to high risk pregnancy was from the rural provinces of North-Western, Central, Eastern and Luapula at 77.59 percent, 77.51 percent, 77.43 and 77.41 percent respectively. The urban provinces of Lusaka and Copper-belt recorded the lowest amongst all the provinces though the figures are also high at 65.77 percent and 69.19 percent respectively. Of the women who resided in rural areas, 78 percent were significantly exposed to the risk compared to 65 percent of women residing in urban areas. An analysis of wealth status revealed that 80 percent of women from poor households were exposed to the risk of high risk pregnancy whilst 77 percent and 65 percent from the average and rich households were exposed to the risk. Also, 76 percent of the working mothers were exposed to high risk pregnancy compared to 69 percent of the non-working mothers.

The highest proportion (84 percent) exposed to high risk pregnancy was from the category of women with no education whilst only 59 percent were exposed from the category of women with post primary education level. Of the women who delivered at home only 21 percent were not exposed to high risk pregnancy whilst 36 percent of the women who utilised the health facility were not exposed to high risk pregnancy. On the other hand, 77 percent of women who did not use skilled personnel at delivery were exposed to high risk pregnancy. In terms of marital status,

of the women who were never married, only two in five women (38 percent) were exposed to high risk pregnancy whilst from the married and formerly married group 75 percent and 80 percent were exposed to high risk pregnancy respectively.

**Table 4.3: Percentage distribution of women's background aspects with exposure to High Risk Pregnancy (HRP), ZDHS 2007**

| | Total Number | No Risk % | Risk % | P-Value |
|---|---|---|---|---|
| **Place of Residence** | | | | 0.0000 |
| Urban | 2032 | 35.07 | 64.93 | |
| Rural | 3388 | 21.77 | 78.23 | |
| **Wealth Status** | | | | 0.0000 |
| Poor | 2104 | 20.34 | 79.66 | |
| Average | 1040 | 22.78 | 77.22 | |
| Rich | 2276 | 34.51 | 65.49 | |
| **Employment Status** | | | | 0.0000 |
| Working | 2937 | 22.83 | 76.17 | |
| Not working | 2483 | 30.23 | 69.77 | |
| **Highest education level** | | | | 0.0000 |
| None | 674 | 16.4 | 83.6 | |
| Primary | 3206 | 21.93 | 78.07 | |
| Secondary/Higher | 1540 | 41.33 | 58.67 | |
| **Marital Status** | | | | 0.0000 |
| Never married | 410 | 61.67 | 38.33 | |
| Currently married | 4166 | 24.75 | 75.25 | |
| Formerly married | 844 | 19.72 | 80.28 | |
| **Place of delivery** | | | | |
| Health Centre | 2161 | 36.09 | 63.91 | 0.0000 |
| Home | 2985 | 22.09 | 78.91 | |
| **Skilled delivery at birth** | | | | 0.0000 |
| Yes | 1983 | 35.5 | 64.5 | |
| No | 2163 | 22.83 | 77.17 | |
| **Problem to get to Health facility** | | | | 0.0000 |
| No problem | 3035 | 29.54 | 70.46 | |
| Problem | 2385 | 23.15 | 76.85 | |
| **Province** | | | | 0.0001 |
| Central | 512 | 22.49 | 77.51 | |
| Copperbelt | 898 | 30.81 | 69.19 | |
| Eastern | 794 | 23.57 | 76.43 | |
| Luapula | 422 | 23.59 | 76.41 | |
| Lusaka | 787 | 34.23 | 65.77 | |
| Northern | 749 | 25.65 | 74.35 | |
| Northwestern | 295 | 22.41 | 77.59 | |
| Southern | 565 | 24.21 | 75.79 | |
| Western | 399 | 26.96 | 73.04 | |

Table 4.4 displays percentage distributions for the study variables of interest. More than 78 percent with no education were exposed to high risk pregnancy outcome. These indications show that an increase in education reduces rate of exposure to high risk pregnancy outcome. As expected, the women with a high autonomy level had the lowest proportion of exposure to high risk pregnancy outcome, indicating that an increase in decision-making power reduces the risk. The results also showed that the women whose partners desired to have more children had a higher proportion (72 percent) of exposure to high risk pregnancy outcome as compared to those who agreed with their partner.

**Table 4.4 Percentage Distribution of Women by Autonomy, Partner's Education and desire for children by High Risk Pregnancy, ZDHS 2007.**

| Variables | Total No. | % | Exposure to HRP | | P |
|---|---|---|---|---|---|
| | | | No Risk% | Risk% | |
| **Partner's Education** | | | | | 0.0000 |
| **No education** | 216 | 5.4 | 21.7 | 78.3 | |
| **Primary** | 1453 | 36.5 | 26.63 | 73.37 | |
| **Secondary/Higher** | 2311 | 58.1 | 41.09 | 58.91 | |
| | | | | | |
| **Partner's Desire for Children** | | | | | 0.0000 |
| **Same** | 1468 | 55.54 | 38.77 | 61.23 | |
| **More** | 926 | 35.02 | 27.94 | 72.06 | |
| **Fewer** | 250 | 9.44 | 36.73 | 63.27 | |
| **Women who did not know** | -1418 | | | | |
| | | | | | |
| **Level of Autonomy** | | | | | 0.0034 |
| **High** | 3402 | 85 | 35.83 | 64.17 | |
| **Low** | 578 | 15 | 28.46 | 71.54 | |

## Chapter Five - Levels of Maternal Mortality: Application of MDRFI

### 5.0 Introduction

This chapter addresses the first objective which sought to assess the levels of maternal mortality ratios using MDRFI and analyses of the differentials of pregnancy-related risks using survey and routine data.

Firstly, the estimation of maternal mortality ratios by region is presented with the aid of the MDRFI model and the bivariate relationship between exposure to high risk pregnancy and selected factors that could predispose a woman to maternal mortality, are presented. The second section presents differentials of pregnancy-related risks and lifetime risk of maternal death by region using the HMIS 2013 and ZDHS 2007 data set.

### 5.1: Maternal mortality burden and estimation of maternal mortality ratio

This section presents the levels of estimated maternal mortality ratios across region and the bivariate relationship between exposure to high risk pregnancy and selected individual factors.

The Maternal Death Risk Factor Index was used to analyse the maternal risk of death at individual level using the intermediate determinants. To predict MMR for regions, a simple mathematical formula was used that establishes a relationship between the MRDFI and MMR (see table 3.3). Using the Multivariate Logistics Regression model, the mean MDRFI values were entered to predict maternal mortality for each province and also rank maternal mortality burden by province and urban-rural residence.

Tables 5.1 and 5.2 show the 14 intermediate variables and factor loadings used for the development of the mean MDRFI. Figures 5.1 to 5.5 present the mean values of the MDRFI by region, urban-rural residence, education status, and household wealth. Regional mean MDRFI

values show that the maternal mortality burden appeared by far the highest in Northern (mean=246) and Central (mean=226) regions. For instance, compared to Lusaka, the maternal mortality burden is almost two times higher in Northern and Central regions. Next to Central, notably high MDRFI mean values were found in Luapula (mean=222), North-Western (mean=212), Southern (mean=208) and Western (mean=205) regions.

The rural regions of the country constitute about 75 percent of the country's population and significantly influence the overall maternal mortality burden in the country. For instance, save for urban regions, almost all rural districts had notably high MDRFI values. As expected, Lusaka and Copper-belt had the lowest MDRFI (mean=124 and 132) respectively. Rural-urban and socioeconomic differentials in maternal mortality burden were apparent. The mean value of MDRFI for the rural areas was significantly higher than in the urban areas (232 against 114, $p<0.0004$).

The predicted maternal mortality ratios (MMRs) in relation to the mean MDRFI values by region are shown in Figure 5.6/7. According to the prediction (Figure 5.7), the maternal mortality ratio was higher than the national average (591/100 000 live births) in all seven rural regions; the highest being in Northern (738 per 100 000 live births) and Central regions (679 per 100 000 live births). These were followed by Luapula, North-Western, Southern, Western and Eastern regions, with predicted MMRs marginally higher than the national average. The predicted ratios in the two urban regions of Lusaka and Copper-belt are significantly lower than the national average. Although the estimation of maternal mortality ratio for urban regions was lower than the rural regions, the maternal mortality ratio of 300 and above per 100 000 live births is considered high (World Health Organisation 2012).

**Table 5.1: Intermediate determinants of high risk pregnancy by residence, wealth status and region, ZDHS 2007**

| | High risk reproductive status | | Poor Health Status | | | Lack of use of maternal health services | | | | | | Indicator of lack of obstetric care | | Indicator of lack of health services |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % Two+ pregnancy related risks | % Malaria risk | % Risk BMI | % Aborted | % HIV risk | % No four ANC | % No assistance at delivery | % No two TTI | % Delivered at home | % No PPC | % No use modern FP | % No CS | % No Doctor present at birth | % Problem to get to health centre |
| **Residence** | | | | | | | | | | | | | | |
| **Urban** | 64.93* | 10.8* | 29.53* | 17.17 | 54.51* | 40.2 | 19.47* | 71.68 | 14.68* | 44.71* | 19.77* | 93.34* | 91.96* | 19.56* |
| **Rural** | 78.23* | 16.88* | 28.91* | 15.15 | 50.82* | 38.29 | 70.47* | 68.5 | 65.9* | 59.66* | 38.23* | 97.97* | 98.12* | 58.55* |
| **Wealth Status** | | | | | | | | | | | | | | |
| **Poor** | 79.66* | 18.77* | 29.12* | 15.33 | 50.53 | 39.27 | 74.58* | 67.4 | 70.11* | 60.74* | 39.42* | 98.49* | 98.53* | 62.7* |
| **Average** | 77.22* | 14.34* | 27.65* | 15.37 | 50.8 | 37.35 | 66.31* | 70.88 | 61.75* | 58.74* | 41.34* | 98.18* | 98.15* | 52.64* |
| **Rich** | 65.49* | 10.64* | 29.85* | 16.69 | 54.39 | 39.35 | 22.53* | 71.3 | 17.67* | 45.6* | 19.22* | 93.13* | 92.15* | 22.59* |
| **Region** | | | | | | | | | | | | | | |
| **Central** | 77.51* | 23.93* | 26.39* | 18.14* | 60.06* | 44.76 | 65.54* | 69.03* | 62.1* | 63.52* | 40.9* | 98.37* | 97.66* | 55.7* |
| **Copper-belt** | 69.19* | 10.9* | 31.6* | 23.94* | 46.33* | 37.68 | 26.75* | 76.2* | 22.52* | 49.29* | 19.23* | 92.3* | 90.26* | 25.72* |
| **Eastern** | 76.43* | 12.41* | 22.32* | 12.72* | 61.58* | 38.21 | 59.15* | 64.18* | 54.13* | 53.26* | 9.25* | 97.53* | 97.68* | 47.87* |
| **Luapula** | 76.41* | 11.38* | 34.49* | 9.21* | 37.17* | 31.99 | 68.4* | 75.42* | 64.23* | 48.11* | 55.82* | 96.64* | 99.57* | 37.56* |
| **Lusaka** | 65.77* | 15.78* | 29.92* | 14.02* | 56.9* | 43.54 | 23.21* | 70.37* | 19.03* | 43.22* | 19.3* | 93.92* | 92.93* | 26.86* |
| **Northern** | 74.35* | 18.8* | 31.68* | 12.55* | 36.38* | 38.17 | 74.45* | 57.94* | 68.47* | 68.23* | 51.51* | 97.77* | 97.28* | 68.25* |
| **NorthWestern** | 77.59* | 12.75* | 30.72* | 16.64* | 49.76* | 36.86 | 59.91* | 66.44* | 54.77* | 66.25* | 44.37* | 98.74* | 97.52* | 53.32* |
| **Southern** | 75.79* | 13.62* | 25.9* | 17.6* | 64.34* | 38.75 | 60.97* | 78.38* | 57.46* | 54.87* | 25.53* | 97.22* | 97.57* | 44.8* |
| **Western** | 73.04* | 14.09* | 32.19* | 15.44* | 58.05* | 38.69 | 59.37* | 73.26* | 53.35* | 47.95* | 48.41* | 98.52* | 98.34* | 48.62* |

***p<0.05**

**Table 5.2: Individual factors PCA output, ZDHS 2007**

| VARIABLE | FACTOR 1 | UNIQUENESS |
|---|---|---|
| High Risk Pregnancy | 0.1796 | 0.8823 |
| Malaria Risk | 0.1930 | 0.8856 |
| BMI Risk | 0.0662 | 0.9503 |
| Abort | 0.0793 | 0.9455 |
| HIV Risk | -0.0354 | 0.9622 |
| Less ANC visits | 0.1195 | 0.9081 |
| Skilled Delivery | 0.8989 | 0.1162 |
| No 2 TTI | 0.0627 | 0.8816 |
| Place of Delivery | 0.9358 | 0.1059 |
| PPC | 0.2378 | 0.8678 |
| Use of Modern contraceptive | 0.1981 | 0.8798 |
| C-Section at delivery | 0.2187 | 0.6243 |
| Doctor present at delivery | 0.1853 | 0.5550 |
| Distance to facility | 0.3176 | 0.8563 |

**Figure 5.1: Mean MDRFI value by place of residence, ZDHS 2007**


**Figure 5.2 Mean MDRFI value by women's household wealth status, ZDHS 2007**

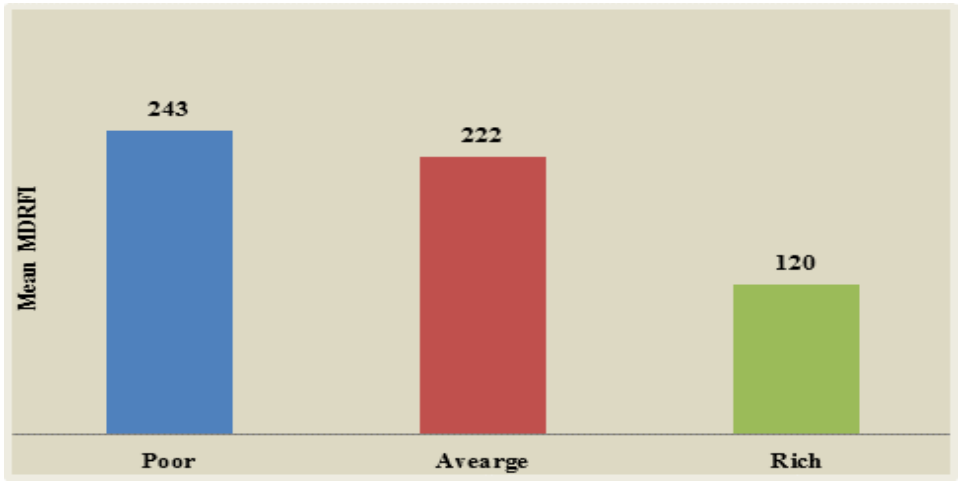


**Figure 5.3 Mean MDRFI value by women's highest education status, ZDHS 2007**

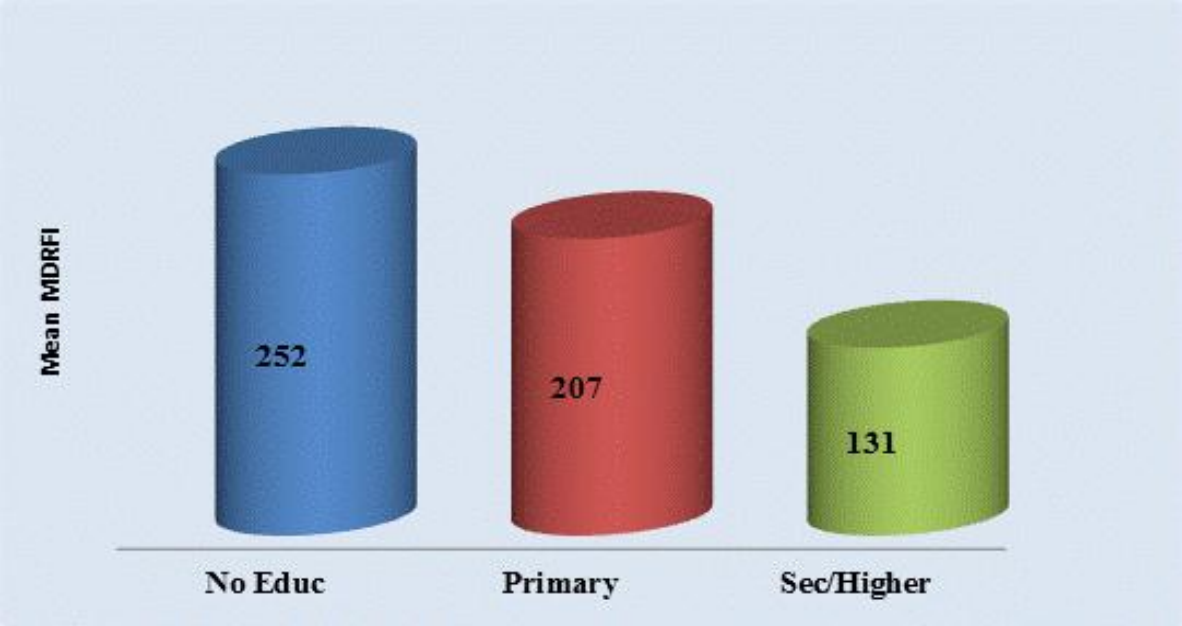



**Figure 5.4 Mean MDRFI value by household wealth and place of residence, ZDHS 2007**

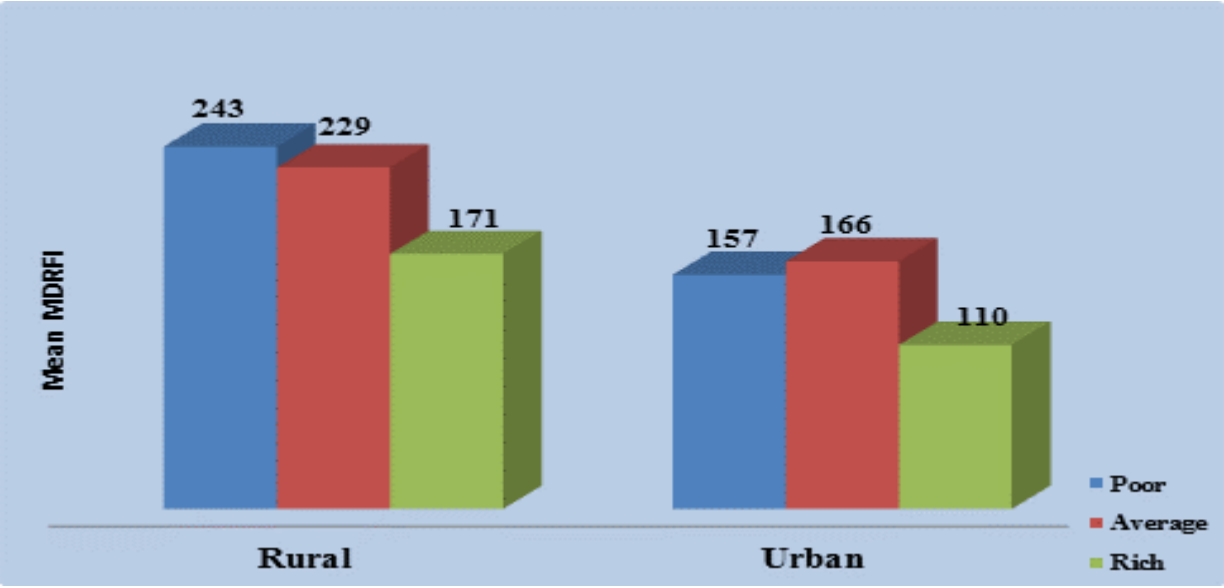


**Figure 5.5: MDRFI values and predicted MMR per 100 000, ZDHS 2007**

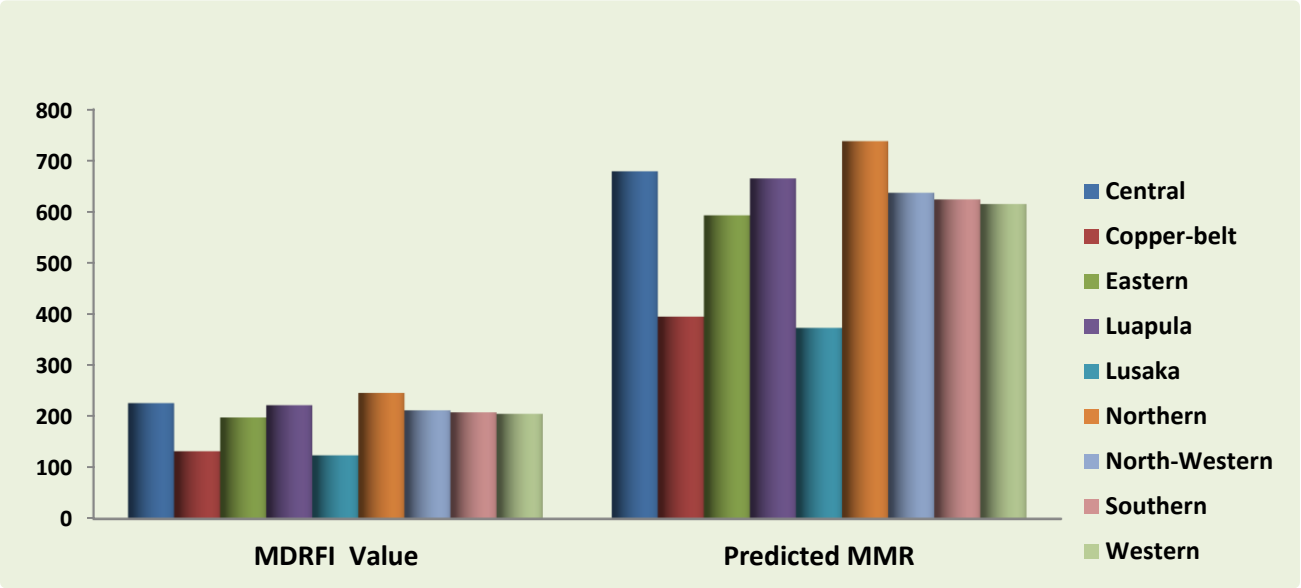
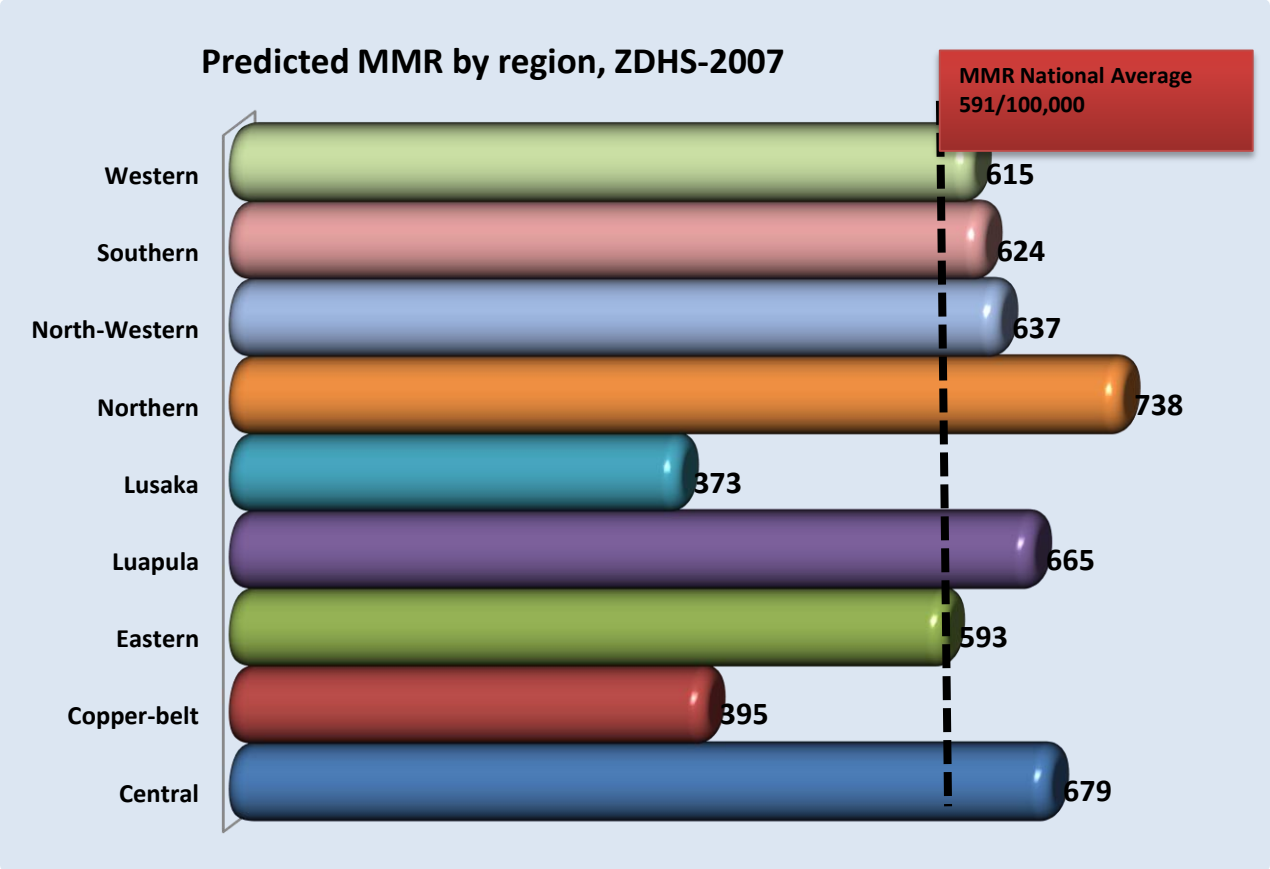



**Figure 5.6: Predicted MMR by region, ZDHS 2007**



## 5.2 Levels of high risk pregnancy by women's reproductive status

This section presents the levels of high risk pregnancy.

### 5.2.1 High risk pregnancy by reproductive status

Previous studies have shown that among the factors that contribute to maternal death are pregnancies that are too early, too close, too late or too many (Nove et al. 2014; Sonneveldt et al. 2013; Ngowa et al. 2013). These conditions are of high risk to the health of the mother. The analysis is restricted to women who had a live birth in the five years preceding the survey.

Table 5.3 presents the distribution of women according to their exposure to high risk pregnancy. Younger maternal age (less than 19 years) at pregnancy was reported at an average of 4 percent ranging from 3 percent to 6 percent across the provinces. The population average for closely spaced pregnancy was reported at 18 percent, whilst the prevalence across provinces ranged from the highest of 23 percent in Northern to the lowest 14 percent in Western Province. Women with high parity were reported at 65 percent with the prevalence across the provinces ranging from the highest, Luapula at 72 percent, to the lowest, Lusaka at 55 percent. Pregnancy and child birth among respondents aged 35 or older was reported at 23 percent in the population whilst Eastern Province had the highest at 35 percent and Luapula the lowest at 29 percent. Analysis of a combination of risk factors of more than one revealed that Eastern and Luapula had the highest percentages of 73 percent each for being too old at pregnancy and having too many children. Population average for young mothers/older mothers with three or more children at pregnancy was reported by 68 percent and 65 percent respectively, whilst young women becoming pregnant too soon (less than 25 months), was reported by 21 percent.

The proportion of women who were exposed to two or more fertility-related high-risk pregnancies by residence and province is further shown in Table 5.3. The data revealed that women in North-Western and Central provinces were the most exposed to high risk pregnancy at 77.59 percent and 77.51 percent

respectively, whilst the urban provinces, Lusaka and Copper-belt, had the lowest at 65.77 percent and 69.19 percent respectively.

Figure 5.7 shows the high risk pregnancy adjusted predictions across the country during the surveyed period. This is in line with the results from Table 5.3 showing the percentage distribution of high risk pregnancy.

**Table 5.3: Percentage (weighted) distribution of women who had a live birth in the five years preceding the 2007 DHS survey according to high risk pregnancy by province and residence**

| | Total Number | Less than 19 years % **(A)** | Older than 35 years % **(B)** | Short birth interval % **(C)** | CEB-3 and above % **(D)** | Too Young Too Soon % **(A/C)** | Too Young Too Many % **(A/D)** | Too soon Too many % **(C/D)** | Too old Too many % **(B/D)** | Too old Too Soon % **(B/C)** | High risk pregnancy % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Population | 5420 | 3.667* | 31.95 | 17.57*** | 64.62*** | 21.19** | 68.29*** | 83.45*** | 67.7*** | 19.15** | **73.24***** |
| Residence | | | | | | | | | | | |
| Urban | 2032 | 3.877 | 31.87 | 15.45 | 54.94 | 19.27 | 58.82 | 77.62 | 59.09 | 17.06 | **64.93** |
| Rural | 3388 | 3.541 | 32 | 19.1 | 70.43 | 22.22 | 73.97 | 86.55 | 72.86 | 20.27 | **78.23** |
| Province | | | | | | | | | | | |
| Central | 511.5 | 4.678 | 31.28 | 14.19 | 67.92 | 18.6 | 72.6 | 85.95 | 69.85 | 14.95 | **77.51** |
| Copperbelt | 898 | 3.238 | 33.76 | 15.31 | 59.67 | 18.55 | 62.91 | 79.8 | 63.49 | 16.67 | **69.19** |
| Eastern | 793.5 | 2.372 | **34.61** | 19.99 | **70.14** | 22.16 | 72.51 | **86.93** | **73.2** | **21.46** | **76.43** |
| Luapula | 422.3 | 2.936 | 29 | 20.53 | **71.72** | 22.98 | **74.65** | **86.94** | **73.07** | **21.04** | **76.41** |
| Lusaka | 786.7 | 4.041 | 31.06 | 16.57 | 55.42 | 20.06 | 59.46 | 78.07 | 60 | 18.37 | **65.77** |
| Northern | 748.8 | 2.793 | 33.05 | 22.44 | 68.96 | 24.86 | 71.75 | 85.94 | 71.47 | **22.98** | **74.35** |
| Northwestern | 294.7 | 4.671 | 29.69 | **23.27** | **68.96** | **27.01** | **73.63** | **87.53** | 71.03 | 24.44 | **77.59** |
| Southern | 565.1 | 4.204 | 30.36 | 15.09 | 63.91 | 19.31 | 68.11 | 82.37 | 66.78 | 16.84 | **75.79** |
| Western | 399.2 | **6.087** | 30.22 | 13.5 | 60.91 | 19.56 | 67 | 80.57 | 64.69 | 16.3 | **73.04** |

**Figure 5.7: Percent distribution of high risk pregnancy across the regions of Zambia, ZDHS 2007**

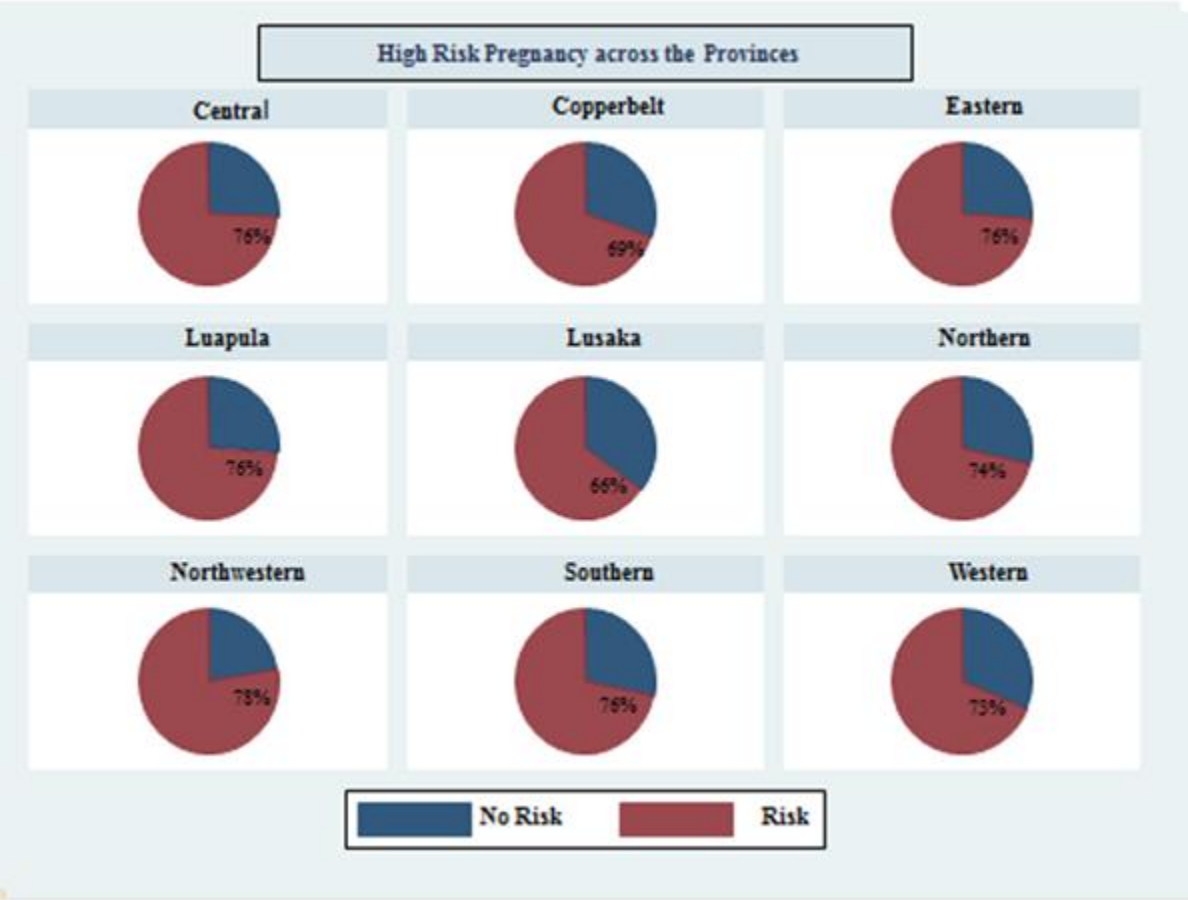



**Table 5.4: Adjusted odds ratios and confidence interval, ZDHS 2007**

| High Risk Pregnancy | Odds Ratio | P>Z | [95% conf. interval] | |
|---|---|---|---|---|
| **Place of Residence (rural)** | | | | |
| **Urban** | .5139533 | 0.000 | .4486806 | .5887218 |
| **Wealth Status (Poor)** | | | | |
| **Average** | .8662244 | 0.136 | .7170789 | 1.046391 |
| **Rich** | | | .4172018 | .5637795 |
| **Highest Education level (None)** | | | | |
| **Primary** | .7005962 | 0.003 | .5549074 | .884535 |
| **Secondary/Higher** | .2782447 | 0.000 | .2183755 | .3545275 |
| **Partner's Education (None)** | | | | |
| **Primary** | .7195648 | 0.047 | .5197515 | .9961942 |
| **Secondary/Higher** | .3602946 | 0.000 | .2625075 | .4945084 |
| **Partner's Desire Children (Both)** | | | | |
| **More** | 1.700322 | 0.000 | 1.360214 | 2.12547 |
| **Fewer** | 1.102049 | 0.579 | .7818512 | 1.553381 |

| | | | | |
|---|---|---|---|---|
| **Don't Know** | 1.181481 | 0.070 | .9862115 | 1.415413 |
| **Marital Status (Never)** | | | | |
| **Currently married** | 4.889588 | 0.000 | 3.923263 | 6.093925 |
| **Formerly married** | 6.549605 | 0.000 | 4.956546 | 8.654682 |
| **Occupation (Not working)** | | | | |
| **Professional** | 1.223853 | 0.021 | 1.031281 | 1.452386 |
| **Manual/Agricultural** | 1.734477 | 0.000 | 1.487787 | 2.022072 |
| **Modern Method (Non user)** | | | | |
| **Non Modern** | 1.363865 | 0.038 | 1.018004 | 1.82723 |
| **Modern Method** | .9902541 | 0.895 | .8562935 | 1.145172 |
| **Autonomy Level (High)** | | | | |
| **Low** | 1.189618 | 0.082 | .9781468 | 1.446808 |
| **Province (Lusaka)** | | | | |
| **Western** | 1.405285 | 0.010 | 1.085402 | 1.819442 |
| **Northern** | 1.509158 | 0.002 | 1.163625 | 1.957294 |
| **Central** | 1.812236 | 0.000 | 1.377635 | 2.383942 |
| **Eastern** | 1.688111 | 0.000 | 1.312978 | 2.170424 |
| **Luapula** | 1.685787 | 0.000 | 1.286507 | 2.208988 |
| **North-Western** | 1.801741 | 0.000 | 1.37078 | 2.368192 |
| **Southern** | 1.62324 | 0.000 | 1.260422 | 2.090497 |
| **Copper-belt** | 1.165406 | 0.235 | .9054845 | 1.499938 |

### 5.2.2: Determinants of regional differentials of high risk pregnancy in Zambia

Factors that could influence women's exposure to high risk pregnancy were examined in Table 5.5. The outcome variable of interest was the odds of exposure to high risk pregnancy (HRP). The explanatory variables used were place of residence, wealth status, marital status, highest education attainment, employment status, place of delivery, distance to health facility and presence of skilled delivery personnel at birth.

Considering the results based on the entire country, the first model shows that marital status, education, employment status, place of delivery and use of skilled attendance at birth significantly influence exposure to high risk pregnancy. For example, in terms of education, relative to the base category of no education, it is evident that the more learned the woman is, the fewer the chances are to be exposed to high risk pregnancy shown by the women who had secondary/higher education with reduced odds of 60 percent

(AOR= 0.403, 95 percent CI: (0.29-0-55). The same applies to place of delivery. Delivering at home was 84 percent more prone to the risk than women delivering at a health facility (AOR= 1.844, 95 percent CI: (2.91-2.64).

Marital status across the whole province was highly significant with the formerly and currently married having higher odds of exposure to the risk than the never married. Place of residence was only significant in Lusaka at 47 percent reduced odds (AOR= 0.529, 95 percent CI: (0.23-1.21) of exposure for urban women compared to rural women. Of the entire population, wealth status was only significant in Central Province with the rich having a 71 percent (AOR= 0.294, 95 percent CI: (0.09-0.91) reduced chance of exposure to the risk compared to the poor.

**Table 5: Determinant of Provincial exposure to High Risk Pregnancy differentials in Zambia**

| Variables | All | Central | C/belt | Eastern | Luapula | Lusaka | Northern | N/western | Southern | Western |
|---|---|---|---|---|---|---|---|---|---|---|
| **Residence** | | | | | | | | | | |
| **Urban** | | | | | | 0.529* | | | | |
| | | | | | | 0.23-1.21 | | | | |
| **Wealth Index** | | | | | | | | | | |
| **Average** | | 0.364*** | | | | | | | | |
| | | 0.16-0.82 | | | | | | | | |
| **Rich** | | 0.294*** | | | | | | | | |
| | | 0.09-0.91 | | | | | | | | |
| **Marital Status** | | | | | | | | | | |
| **Currently** | 2.900*** | 2.978** | 3.775*** | 4.092*** | 5.692*** | 2.202* | 13.05*** | 2.492** | 1.801* | 2.213*** |
| | 2.21-3.79 | 1.21-7.29 | 1.63-8.72 | 1.33-12.6 | 2.24-14.4 | 0.95-5.12 | 3.44-49.5 | 1.18-5.28 | 0.84-3.86 | 1.37-3.57 |
| **Formerly** | 4.079*** | 3.827** | 4.197** | 3.877** | 3.819** | 4.274** | 16.34*** | 3.555*** | 3.902*** | 5.157*** |
| | 2.87-5.79 | 1.13-13.0 | 1.67-10.6 | 2.94-16.0 | 1.16-12.5 | 1.29-14.1 | 3.84-69.6 | 1.56-8.09 | 1.48-10.3 | 1.99-13.3 |
| **Highest Educ.** | | | | | | | | | | |
| **Primary** | | | | 0.536** | | 0.320* | | | | |
| | | | | 0.29-1.0 | | 0.09-1.03 | | | | |
| **Sec/Higher** | 0.403*** | | 0.086** | 0.465** | 0.398* | 0.096*** | 0.376** | | | |
| | 0.29 -0.55 | | 0.01-0.72 | 0.22-0.99 | 0.13-0.87 | 0.03-0.29 | 0.15-0.95 | | | |
| **Employment Status** | | | | | | | | | | |
| **Not working** | 0.792*** | | | 0.477*** | 0.564** | | | 0.514* | | 0.618* |
| | 0.69-0.91 | | | 0.33-0.69 | 0.36-0.89 | | | 0.28-0.43 | | 0.36-0.97 |
| **Place of Delivery** | | | | | | | | | | |
| **Home** | 1.844*** | | | | 3.065* | 4.651** | | | | |
| | 1.29-2.64 | | | | 0.85-0.97 | 1.32-16.5 | | | | |
| **Distance** | | | | | | | | | | |
| **Problem** | | | 2.044** | | | 0.615* | | | | |
| | | | 2.97-4.29 | | | 1.33-1.87 | | | | |
| **Skilled delivery** | | | | | | | | | | |
| **Skilled** | 0.707** | | | | | 0.288** | | | | |
| | 0.49-0.92 | | | | | 0.07-0.26 | | | | |
| **Prob > F** | **■² 0.0000** | **■² 0.0133** | **■² 0.0001** | **■² 0.0003** | **■² 0.0056** | **■² 0.0003** | **■² 0.0194** | **■² 0.0002** | **■² 0.0007** | **■² 0.0055** |

**Robust standard errors *** p<0.01, ** p<0.05, * p<0.1**

### 5.2.3: Autonomy, partner's desire for children and education on high risk pregnancy

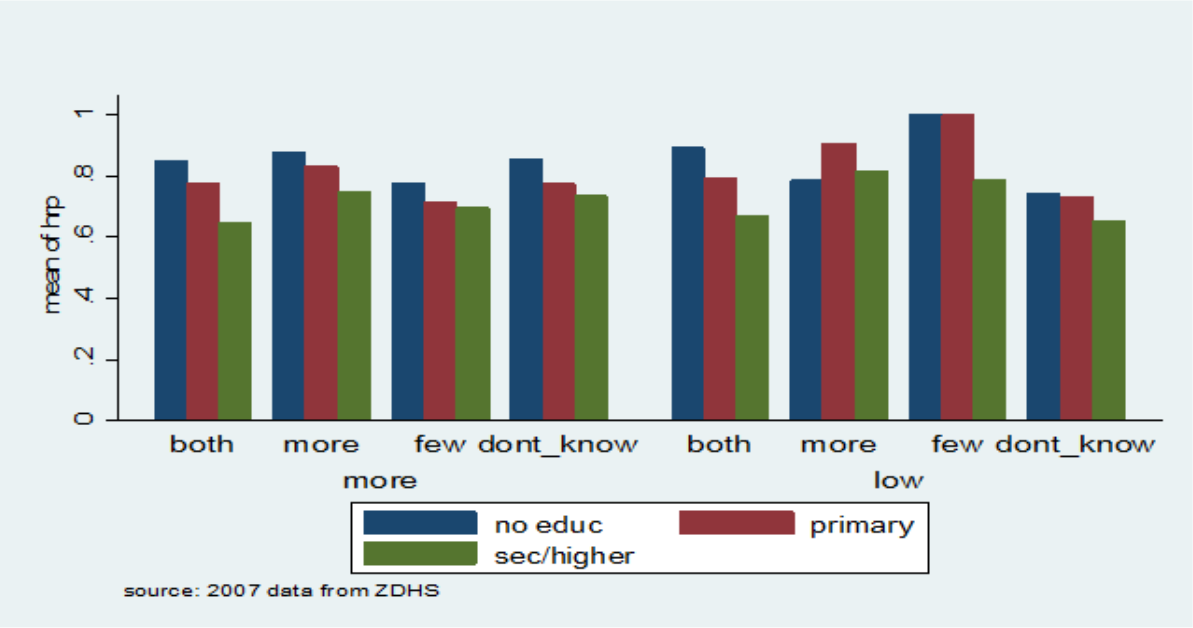
In this section, we investigated the influence of other aspects of the sociocultural environment that could predispose a woman to adverse pregnancy outcome. Women's influence in the household is one such sociocultural risk factor (Story & Burgard 2012). Gender inequality, poverty and discrepancies in women's and girls' access to health, education and income as well as sociocultural status are all key factors that have been found to impact maternal health (Bianco & Moore 2012). This section, therefore, examines the influence of women's autonomy, partner's desire for children and partner's education in exposing women to maternal health risk in Zambia.

In Figure 5.8, comparison of women according to their decision-making power related to their partner's desire for children and partner's education in terms of influence to exposure to high risk pregnancy, was analysed. Results show that women whose partners had no education regardless of their autonomy level but who agreed on the number of children, had a higher mean compared to the primary and secondary partners. The pattern for the mean of high risk pregnancy was the same for women who agreed with their partners on the number of children. Women whose partners had no education had the highest mean of exposure to the risk, followed by those with primary education. The lowest mean was recorded amongst women who had secondary/highest education.

Higher means was recorded amongst the women who had a low autonomy level with primary education partners, those who had a high autonomy level and husbands who desired more children including women whose partners had no education. However lower mean was recorded amongst women who had lower autonomy level and whose partners had no education. This is a surprising result as it shows women with low autonomy level and partners with no education having a lower mean compared to their counterparts with primary education. This can indicate that no education and primary education have a thin line of separation. Generally, the higher means were observed among women who had low autonomy compared to

high autonomy. Surprisingly, women with low autonomy whose partners desired few children had the highest mean in the category of partners with no education and primary education. This shows that education has a greater effect on autonomy and exposure to high risk pregnancy. This is evidenced by the results in almost all categories for women with partners with no education and primary education having higher mean exposure to high risk pregnancy.

**Figure 5.8: Mean exposure to high risk pregnancy by autonomy level, partner's education and desire for children, ZDHS 2007**



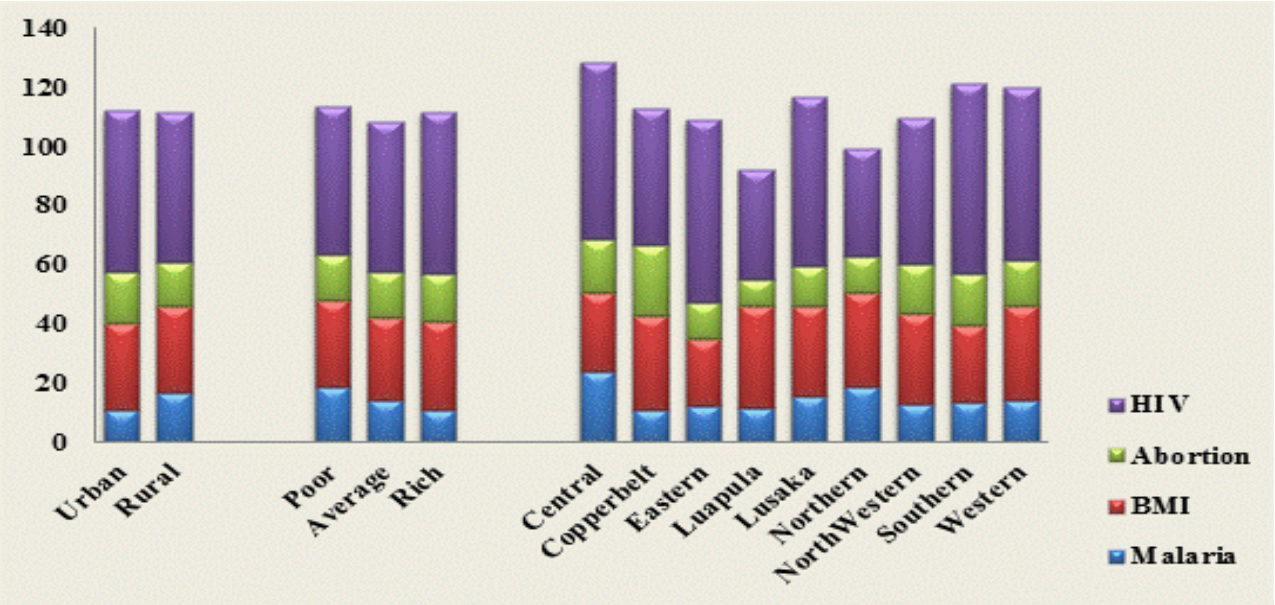

### 5.2.4: Women's health status

There is emerging evidence of importance, particularly in pregnant women, of the complication of both malaria and HIV infection in sub-Saharan Africa. Increased risks of malaria in HIV positive women have been associated with maternal and infant mortality (Brentlinger et al. 2006). Some researchers have identified body mass index (BMI) that is too high or too low and abortion as risk factors of adverse birth outcomes (Denison et al. 2014; Grimes et al. 2006) This section presents levels, patterns and determinants of maternal health status measured through women's health based on the assessment of risk of malaria, HIV risk, termination of pregnancy and nutritional status (BMI).

### 5.2.4.1 Levels and patterns of indication of poor health status

Poor health status was indicated by risk of HIV, abortion, low or high BMI and malaria risks. Malaria risk was observed to be high (17 percent) amongst rural residents whilst BMI, abortion and HIV were found to be high in urban residents at 30 percent, 17 percent and 55 percent respectively. Assessment of health status according to the women's wealth status indicated that malaria and BMI were highest at 19 percent and 29 percent respectively amongst the poor whilst BMI was highest amongst the rich. However, abortion and HIV were high across the rural and urban residences at an average of 15 percent and 51 percent respectively. Across the provinces, the results further revealed that women in Central Province had the highest risk of malaria at 24 percent whilst Luapula, Western, Northern and Copper-belt had the highest risk of BMI at 34 percent and 32 percent for the others respectively. Abortion was recorded highest in Copper-belt whilst HIV was lowest in Northern and Luapula at 36 percent and 37 percent respectively.

**Figure 5.9: Assessment of poor health status by HIV, abortion, BMI and malaria, ZDHS 2007**




### 5.2.4.2: Factors influencing poor health status

Table 5.6 presents the adjusted odds ratio (AOR) and 95 percent confidence interval (CI) of a multivariate logistic regression model of the likelihood of having poor health status. Several prognoses of poor health

status have been identified in this analysis, including region of residence, marital status, age, women and partner's education, occupation and number of children. Compared to women in Central Province, women in other provinces had less likelihood of exposure to poor health status. However, Luapula and Northern had the most significant reduced chance of exposure at 61 percent and 51 percent respectively.

The odds of poor health status were 3.6 times greater in women aged 35 to 49 compared to the age group of 15 to 19. Similarly, the formerly married were twice as likely to be exposed to poor health status compared to the never married. The adjusted excess odds of poor health status varied between 1.3 to 1.4 times for women who did not know how their partners felt about number of children, the professional and manual workers and women who had three or more children. Surprisingly, women who had three or more children under five had lower odds of 22 percent compared to those with less than three children under five.

**Table 5.6: Multivariate logistic regression analysis of risk of poor health status**

| Poor Health Status | Odds Ratio | P>Z | [95% conf. | interval] |
|---|---|---|---|---|
| **Place of Residence (rural)** | | | | |
| **Urban** | 1.132893 | 0.126 | .9656497 | 1.329101 |
| **Wealth Status (Poor)** | | | | |
| **Average** | .9933735 | 0.947 | .8167047 | 1.208259 |
| **Rich** | 1.130727 | 0.155 | .9544684 | 1.339535 |
| **Respondents Age (15-19)** | | | | |
| **20-34** | 1.368528 | 0.019 | 1.053201 | 1.778263 |
| **35-49** | 3.616886 | 0.000 | 2.664738 | 4.909249 |
| **Highest Education level (None)** | | | | |
| **Primary** | .7950816 | 0.068 | .6217909 | 1.016668 |
| **Secondary/Higher** | .7071242 | 0.010 | .5424299 | .9218235 |
| **Partners Education (None)** | | | | |
| **Primary** | .6265778 | 0.008 | .443255 | .88572 |
| **Secondary/Higher** | .6205111 | 0.006 | .4407469 | .8735942 |
| **Partner's Desire Children (Both)** | | | | |
| **More** | 1.083257 | 0.487 | .8643488 | 1.357607 |
| **Fewer** | .9103844 | 0.609 | .6356067 | 1.303951 |
| **Don't Know** | 1.279701 | 0.016 | 1.04713 | 1.563925 |
| **Marital Status (Never)** | | | | |
| **Currently married** | 1.283531 | 0.054 | .9957423 | 1.654496 |
| **Formerly married** | 2.183247 | 0.000 | 1.567027 | 3.041792 |
| **Occupation (Not working)** | | | | |
| **Professional** | 1.391704 | 0.001 | 1.136952 | 1.703537 |
| **Manual/Agricultural** | 1.286199 | 0.003 | 1.087208 | 1.521611 |
| **Modern Method(Non user)** | | | | |
| **Non Modern** | .8028367 | 0.149 | .5956972 | 1.082004 |
| **Modern Method** | .9325653 | | .792137 | 1.097889 |
| **Autonomy Level(High)** | | | | |
| **Low** | 1.192012 | 0.108 | .9620233 | 1.476983 |
| **Children Ever Born(<3)** | | | | |
| **More (>=3)** | 1.382787 | 0.000 | 1.18627 | 1.61186 |
| **Under 5 children(<3)** | | | | |
| **More (>=3)** | .7801694 | 0.018 | .6346861 | .9590004 |
| **Province (Central)** | | | | |
| **Copperbelt** | .5929707 | 0.002 | .4259653 | .8254528 |
| **Eastern** | .7174469 | 0.049 | .5156777 | .9981623 |
| **Luapula** | .3911193 | 0.000 | .2818603 | .5427308 |
| **Lusaka** | .7424894 | 0.087 | .5282316 | 1.043653 |
| **Northern** | .4137351 | 0.000 | .2993385 | .5718502 |
| **Northwestern** | .5966143 | 0.003 | .4241979 | .8391098 |
| **Southern** | .9336255 | 0.698 | .660057 | 1.320578 |
| **Western** | .739032 | 0.085 | .5237123 | 1.042879 |

### 5.2.5: Maternal health services

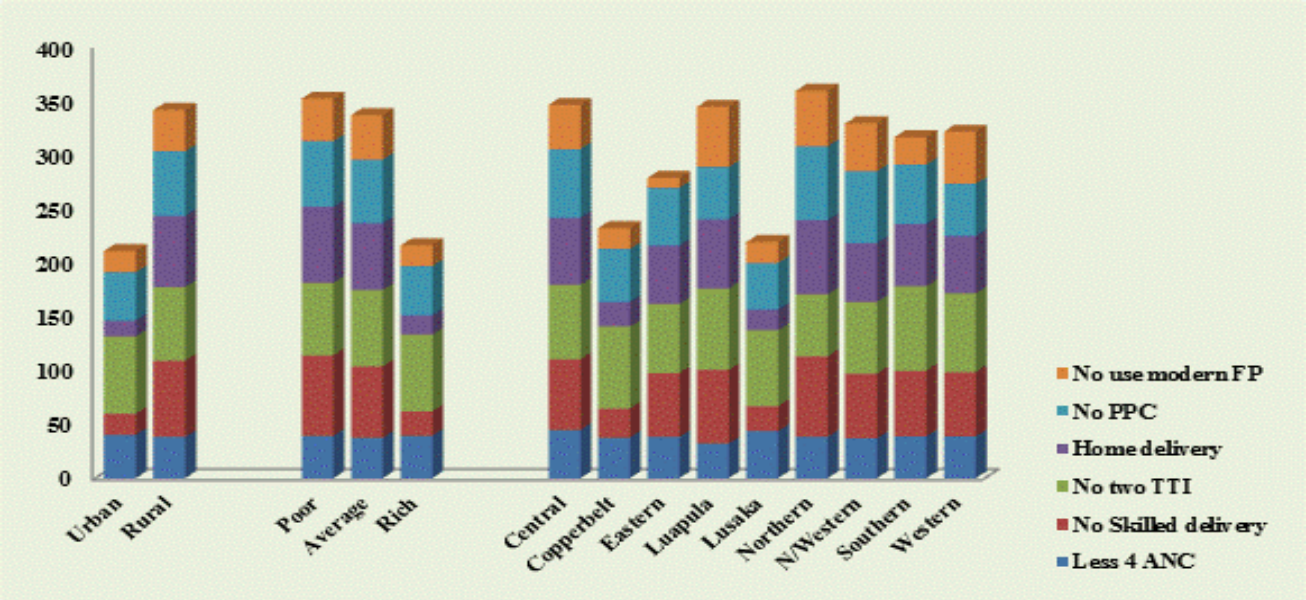
There is sufficient evidence to suggest that adverse birth outcomes are strongly associated with inadequate and poor quality maternal healthcare (Powell-Jackson & Hanson 2012). An increase in antenatal care attendance is directly associated with an increase in the use of skilled birth attendants and general birth preparedness (Nguyen et al. 2012; Brazier et al. 2014; Magoma et al. 2013). This section outlines comprehensive analyses of the levels and determinants of maternal health service indicators, namely antenatal, delivery and postpartum care services.

Assessment of women's non-use of maternal health services appeared to vary in accordance with their place of residence and region. Figure 2 presents the percentage of women by indicators of lack of utilization of maternal health supplies by residence, wealth status and region. Lack of utilization of maternal health supplies was significantly higher in the rural areas than in the urban areas; and the difference was also observed across regions and wealth status. Indicators for rural women in non-use of skilled attendance was recorded at 71 percent, home delivery at 66 percent and non-use of modern family planning at 38 percent, whilst the urban women recorded only 17 percent for no skilled attendance at birth and 15 percent for home delivery. Differentials were also observed by wealth status of the women. Women from the rich status recorded 23 percent for no skilled attendance at birth, 18 percent for home delivery and 19 percent for non-use of modern family planning, against women from the poor category who recorded 75 percent for no skilled attendance at birth and 70 percent for home delivery. The women from the average status however had higher levels of 41 percent for non-use of modern family planning and no TTI at 71 percent compared to the poor who recorded 39 percent and 67 percent respectively.

Across regions, Central recorded highest in women not attending four or more antenatal care visits at 45 percent, whilst Northern, Central and Luapula had the highest for women not using skilled attendance at birth at 75 percent, 66 percent and 68 percent respectively. Less than four antenatal visits were observed across all regions ranging between 32 percent and 45 percent. Women in the urban provinces of Lusaka

and Copper-belt recorded the lowest in home delivery at 19 percent and 23 percent respectively. Most women (68 percent) in Northern Province did not receive postnatal care. Surprisingly, Eastern had the lowest proportion of women not using the modern family planning method at 9 percent.

**Figure 5.10: Levels of maternal health service use across the provinces**




### 5.2.5.1: Factors influencing non-use of maternal health supplies

Table 5.7 presents the adjusted odds ratio (AOR) and 95 percent confidence interval (CI) of a multivariate logistic regression model showing the likelihood of non-use of maternal health services. Several variables were examined in relation to the maternal health service use. These include antenatal care (ANC), place of delivery, skilled delivery at birth, postpartum care (PPC), modern family planning use and tetanus injection (TTI).

Compared to women in rural places, urban women had reduced odds of not using maternal health services of 67 percent. Respondents from rich households had reduced odds of 72 percent compared to the poor households. The influence of level of education and use of maternal health services has been shown by the reduced odds of women with primary education and secondary education at 55 percent and 67 percent

respectively. The same applied to women whose partners had secondary or higher education as they had reduced odds of 71 percent of not using maternal health services compared to the respondents whose partners had no education. Women who were currently married and those whose partners desired more children had increased odds of not using maternal health services of 42 percent and 95 percent compared to the not married and women who agreed with their partners on the number of children.

Respondents employed as professionals had reduced odds of 28 percent whilst their counterparts employed as manual workers or agriculturalists had increased odds of 63 percent compared to those not working. The women with low autonomy level and those who had three or more children had increased odds of 49 percent and 48 percent respectively. Women that used a modern contraceptive method had reduced odds of 37 percent compared to women who were not using any method of contraception.

Both the urban regions, Lusaka and Copper-belt, were 49 percent less likely than women from Central Province to use maternal health services. However, the excess odds of non-use of maternal health services among women from Northern Province compared to women from Central was 68 percent.

**Table 5.7: Multivariate logistic regression analysis of non-use of health services**

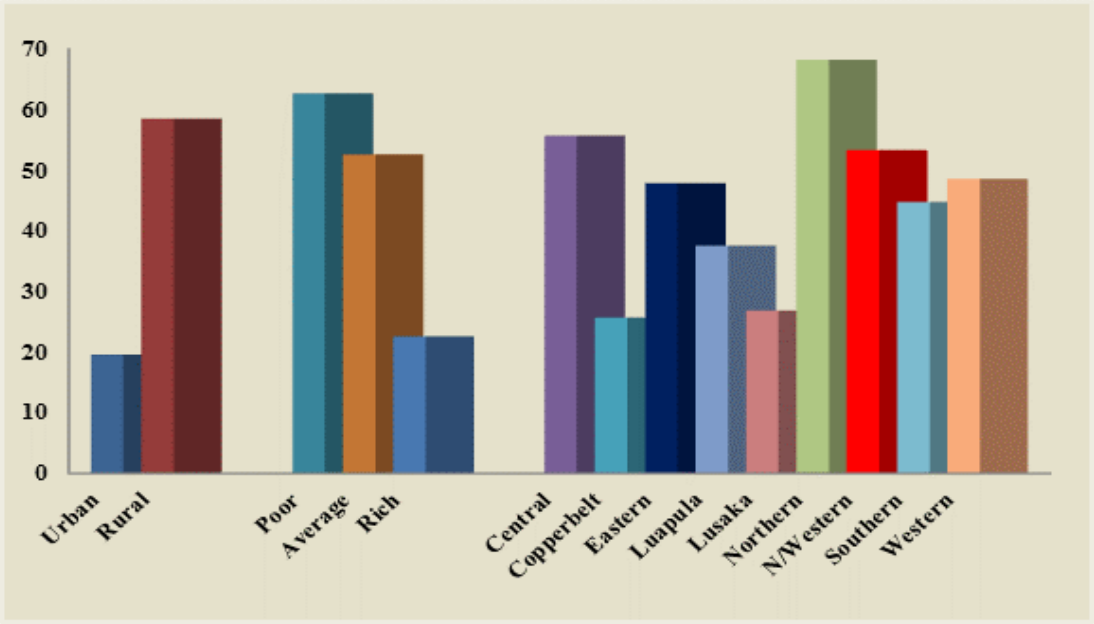
| No Use Health Services | Odds Ratio | P>Z | [95% conf. interval] | |
|---|---|---|---|---|
| **Place of Residence (rural)** | | | | |
| **Urban** | .3263006 | 0.000 | .2715173 | .3921374 |
| **Wealth Status (Poor)** | | | | |
| **Average** | .723698 | 0.017 | .5543911 | .94471 |
| **Rich** | .2755593 | 0.000 | .2229991 | .3405077 |
| **Respondent's Age (15-19)** | | | | |
| **20-34** | .7894583 | 0.169 | .5635833 | 1.10586 |
| **35-49** | 1.042783 | 0.831 | .7089806 | 1.533745 |
| **Highest Education level (None)** | | | | |
| **Primary** | .4452751 | 0.000 | .306194 | .6475303 |
| **Secondary/Higher** | .2297161 | 0.000 | .1561642 | .3379103 |
| **Partner's Education (None)** | | | | |
| **Primary** | .6522013 | 0.088 | .3990142 | 1.066044 |
| **Secondary/Higher** | .2865208 | 0.000 | .1774717 | .462576 |
| **Partner's Desire Children (Both)** | | | | |
| **More** | 1.953321 | 0.000 | 1.462302 | 2.609218 |
| **Fewer** | 1.305542 | 0.240 | .8371258 | 2.036063 |
| **Don't Know** | 1.824184 | 0.000 | 1.430017 | 2.326998 |
| **Marital Status (Never)** | | | | |
| **Currently married** | 1.416295 | 0.019 | 1.057624 | 1.896602 |
| **Formerly married** | 1.11536 | 0.572 | .7640995 | 1.628096 |
| **Occupation (Not working)** | | | | |
| **Professional** | .7191672 | 0.004 | .5736907 | .9015336 |
| **Manual/Agricultural** | 1.627958 | 0.000 | 1.316422 | 2.01322 |
| **Modern Method(Non user)** | | | | |
| **Non Modern** | 1.107985 | 0.603 | .753085 | 1.630135 |
| **Modern Method** | .6264754 | 0.000 | .5191751 | .7559521 |
| **Autonomy Level(High)** | | | | |
| **Low** | 1.493524 | 0.003 | 1.146523 | 1.945547 |
| **Children Ever Born(<3)** | | | | |
| **More (>=3)** | 1.482451 | 0.000 | 1.23484 | 1.779712 |
| **Under 5 children(<3)** | | | | |
| **More (>=3)** | 1.220999 | 0.125 | .9458962 | 1.576114 |
| **Province (Central)** | | | | |
| **Copper-belt** | .5142266 | 0.000 | .3576135 | .7394268 |
| **Eastern** | 1.015672 | 0.934 | .7034967 | 1.466375 |
| **Luapula** | .9144995 | 0.646 | .6241819 | 1.339849 |
| **Lusaka** | .5102187 | 0.000 | .353939 | .7355028 |
| **Northern** | 1.676854 | 0.014 | 1.110905 | 2.531126 |
| **North-Western** | 1.231179 | 0.313 | .8222296 | 1.843525 |
| **Southern** | 1.033214 | 0.863 | .7126329 | 1.498009 |
| **Western** | .7703819 | 0.167 | .5320647 | 1.115444 |

### 5.2.6: Distance indicator of lack of health facility within the community/area

Long distance to a health facility has been associated with delays that increase maternal mortality risk (Pacagnella et al., 2012; Maine et al., 1996). The delays in (i) making the decision to seek care; (ii) reaching an adequate health facility; and (iii) receiving the needed care within a facility i.e. emergency obstetric care (Campbell & Graham 2006; Thaddeus & Maine 1994). This section presents detailed analyses of the levels and determinants of availability of a health facility within reach, an indicator, namely distance.

Fifty nine percent of rural residents indicated that distance was a problem in reaching a health facility compared to 20 percent of urban residents. The problem of distance was also high in the category of women from poor households at 63 percent compared to women from rich households at 23 percent. As expected, women from the provinces within the line of rail, Lusaka and Copper-belt, had a lower proportion of 27 percent and 26 percent respectively, indicating distance as a problem in reaching a health facility. However, Northern Province had the highest at 68 percent followed by Central (56 percent) and North-Western (53 percent).

**Figure 5.11: Levels of distance to health facility as a problem across the provinces, ZDHS 2007**



### 5.2.6.1: Factors influencing non-use of health facilities

Table 5.8 presents the adjusted odds ratio (AOR) and 95 percent confidence interval (CI) of a multivariate logistic regression model. Distance to health facility was examined in relation to lack of health services.

Urban women were significantly less likely to have distance as a problem to get to a health facility than their rural counterparts (OR= .17, CI: .15-.20, P<0.00). As expected, there was less likelihood of lacking access to nearby health facilities among better educated women when compared to those having no education. Women who had received secondary education and above (OR=0.27, CI: 0.22-0.33, P<0.00) and women whose partners had received secondary and higher education (OR=0.30, CI: 0.24-0.38, P<0.00) were significantly less likely to fail to get to a health facility due to distance. Women classified as belonging to the richest and average households had reduced odds of experiencing distance as a problem to get to a health facility compared to women from poor households (OR=0.66, CI: 0.15-0.20, P<0.00).

Women whose partners desired more children or few or who did not discuss the number of children with their partners had higher odds of having distance as a problem compared to those who agreed with their partners on the number of children at 51 percent, 41 percent and 61 percent respectively. Currently married women and formerly married were almost two times as likely to experience problems in reaching a facility due to distance as compared to the never married (OR=1.81, CI: 1.44-2.28, P<0.00 and OR=1.51, CI: 1.16-1.97, P<0.00).

Professional women had reduced odds of 44 percent compared to the non-employed (OR=0.56, CI: 0.48-0.66, P<0.00) whilst the women employed as manual workers or agriculturists were almost two times more likely to have problems in reaching a health facility due to distance (OR=1.95, CI: 1.7-2.23, P<0.00). Autonomy level was also found to be a great predictor of the problem to get to a health facility. Women with low autonomy levels were 2.1 times more likely to have problems as compared to women with high autonomy levels (OR=2.11, CI: 1.78-2.49, P<0.00). Number of children ever born was found to be a predictor. Women with higher parity were more likely to have problems with the distance to get to a

facility (OR=1.44, CI: 1.27-1.63, P<0.00) than the women with less than three children. Region of residence was found to be associated with problems to reach a facility. Women from Northern Province were almost two times more likely to experience a problem to get to a facility due to distance (OR=1.71, CI: 1.33-2.19, P<0.00) compared to women from Central Province. However, women from all the other provinces had reduced odds of complaining about distance as a problem compared to Central Province, with reduced odds ranging from 71 percent in Lusaka to 25 percent for Western.

**Table 5.8: Multivariate logistic regression analysis of lack of health facility nearby**

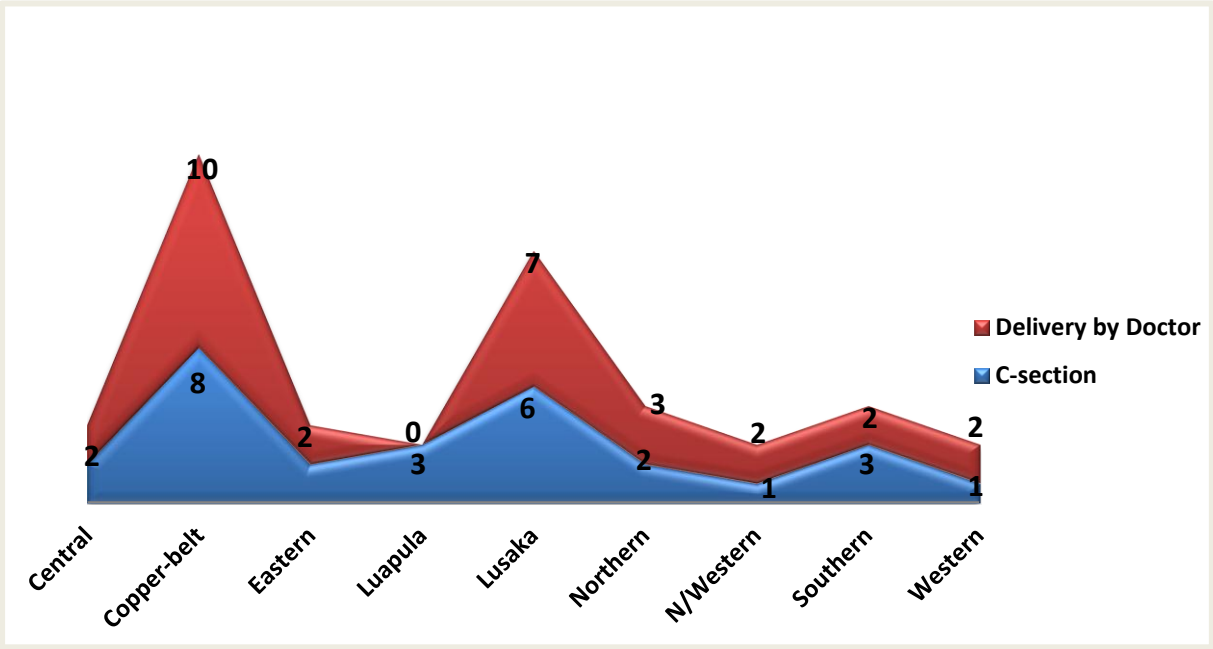
| Lack Health Facilities | Odds Ratio | P>Z | [95% conf. interval] | |
|---|---|---|---|---|
| **Place of Residence (rural)** | | | | |
| Urban | .1721522 | 0.000 | .1487522 | .1992333 |
| **Wealth Status (Poor)** | | | | |
| Average | .6612831 | 0.000 | .5657729 | .772916 |
| Rich | .1736573 | 0.000 | .1500766 | .20094 |
| **Respondents Age (15-19)** | | | | |
| 20-34 | .9531629 | 0.694 | .7503183 | 1.210845 |
| 35-49 | 1.048444 | 0.711 | .8164451 | 1.346368 |
| **Highest Education level (None)** | | | | |
| Primary | .6007144 | 0.000 | .5015782 | .719444 |
| Secondary/Higher | .2660179 | 0.000 | .216849 | .326335 |
| **Partners Education (None)** | | | | |
| Primary | .7049816 | 0.005 | .552696 | .8992268 |
| Secondary/Higher | .3017751 | 0.000 | .2371077 | .3840793 |
| **Partner's Desire Children (Both)** | | | | |
| More | 1.505402 | 0.000 | 1.253415 | 1.808048 |
| Fewer | 1.41164 | 0.002 | 1.042417 | 1.9116 |
| Don't Know | 1.610248 | 0.000 | 1.371825 | 1.890109 |
| **Marital Status (Never)** | | | | |
| Currently married | 1.813554 | 0.000 | 1.444557 | 2.27680 |
| Formerly married | 1.512886 | 0.002 | 1.161359 | 1.970815 |
| **Occupation (Not working)** | | | | |
| Professional | .5609769 | 0.000 | .4753032 | .662093 |
| Manual/Agricultural | 1.946282 | 0.000 | 1.701176 | 2.226703 |
| **Modern Method(Non user)** | | | | |
| Non Modern | 1.598907 | 0.000 | 1.253628 | 2.039284 |
| Modern Method | .6755312 | 0.000 | .5923007 | .7704572 |
| **Autonomy Level(High)** | | | | |
| Low | 2.107607 | 0.000 | 1.784422 | 2.489326 |
| Children Ever Born(<3) | | | | |
| More (>=3) | 1.43567 | 0.000 | 1.267645 | 1.625967 |
| **Under 5 children(<3)** | | | | |
| More (>=3) | 1.23415 | 0.017 | 1.039138 | 1.46575 |
| **Province (Central)** | | | | |
| Copperbelt | .2753079 | 0.000 | .213471 | .3550572 |
| Eastern | .7302982 | 0.009 | .5770722 | .9242092 |
| Luapula | .4784205 | 0.000 | .3699765 | .6186505 |
| Lusaka | .2921108 | 0.000 | .2268339 | .3761729 |
| Northern | 1.709485 | 0.000 | 1.332865 | 2.192525 |
| Northwestern | .9084675 | 0.453 | .7069506 | 1.167427 |
| Southern | .6455021 | 0.000 | .5074789 | .8210646 |
| Western | .7526902 | 0.024 | .5880667 | .9633985 |

### 5.3: Interaction of pregnancy-related risk variables

Caesarean section delivery (an indicator of population access to obstetric care services), was assessed to investigate its interaction with doctor present at delivery. A higher caesarean section percentage suggests the availability of obstetric care, which is offered primarily at health facilities. The WHO has proposed that a rate of 5 to 15 percent is optimal for births through caesarean section in a country, and a rate above 15 percent in a country is not recommended (World Health Organisation, 2012; Gibbons et al., 2010). This indicates that very low and/or very high levels of birth through caesarean section are dangerous.

On the whole, delivery through caesarean section is exceedingly low with a coverage rate as low as 2.13 percent in rural and 7.76 percent in urban areas. In seven out of the nine provinces, the proportion of caesarean delivery was not more than 3 percent. The highest rate of caesarean section delivery was reported in the two urban provinces of Copper-belt at 8 percent and Lusaka at 6 percent. This may well indicate the differential in the availability of obstetric care services by region, the region with the highest rate of caesarean section having higher obstetric care services as indicated by the presence of the doctor at delivery. The regions with high caesarean section delivery rate also had high rates of a doctor present at delivery. Questionable results were observed in Luapula which recorded zero percent for doctor present at delivery but 3 percent for caesarean section delivery.

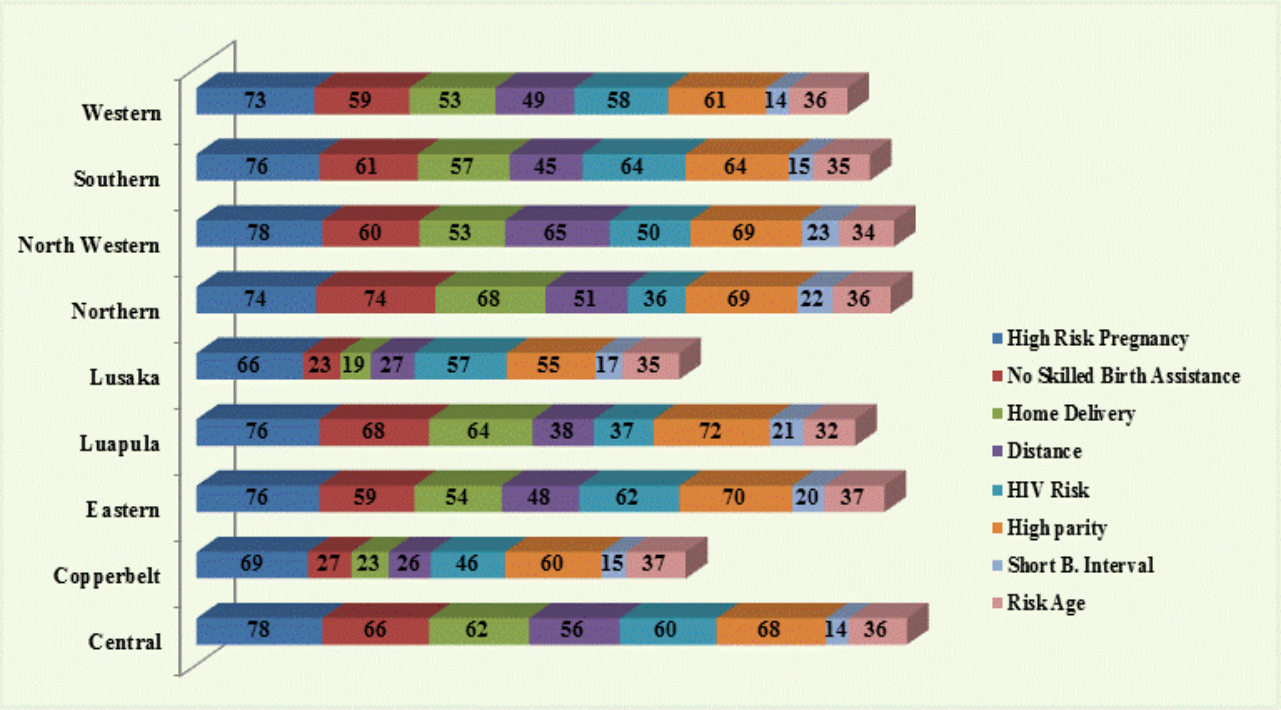
**Figure 5.12: Obstetric care percentage across provinces, ZDHS 2007**




When comparing the risks across the provinces, the results in Figure 5.13 show that the two urban provinces of Lusaka and Copper-belt had the lowest percentages of high risk pregnancy at 66 percent and 69 percent respectively. The majority of women who delivered at home came from Northern Province (68 percent) whilst Lusaka and Copper-belt recorded the lowest percentage in home deliveries at 19 percent and 23 percent respectively. The assessment of women's exposure to HIV risk was highest in Southern and Eastern at 64 percent and 62 percent respectively.

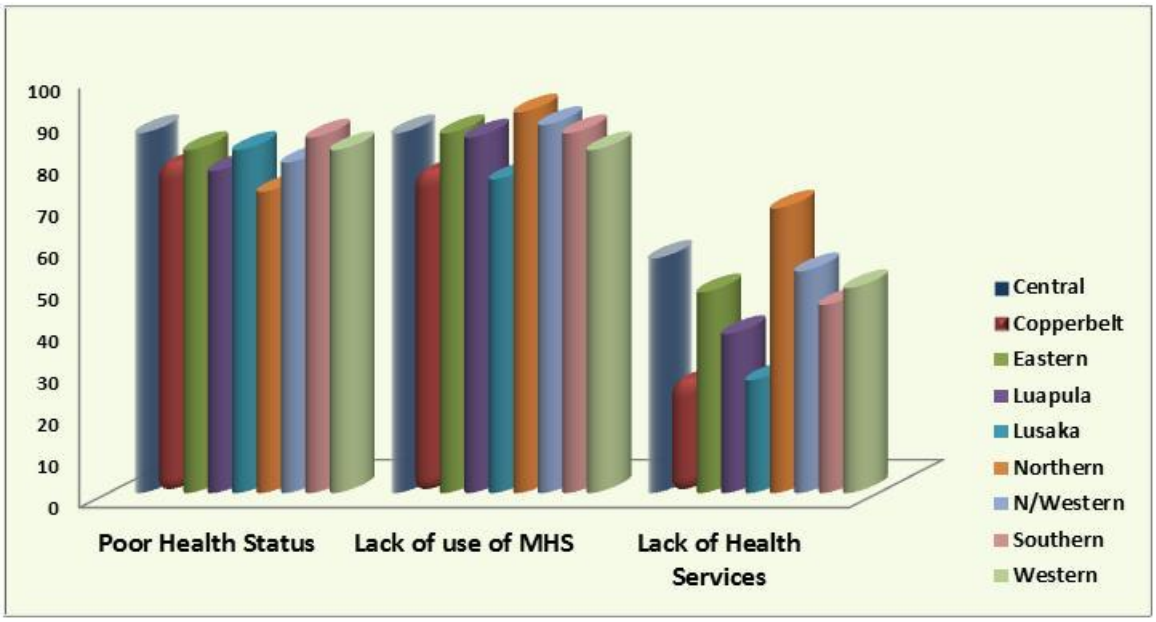
However, Luapula Province recorded the lowest in HIV risk though highest in women with high parity at 72 percent. The highest proportion of women who indicated that distance was a problem was recorded in North-Western province, whilst the majority of women from the provinces along the line of rail of Copperbelt and Lusaka had no problems concerning distance to get to the health facility at 26 percent and 27 percent. Generally, all provinces were at par in terms of women who gave birth or were pregnant during the survey aged less than 19 or above 35 years, ranging between 32 and 37 percent. It is also important to note that almost all rural provinces recorded high risk percentages in the aforementioned risk factors.

**Figure 5.13: Percentage distribution pregnancy risk factors across the provinces, ZDHS 2007**




The assessment of the interaction between women with poor health status, the indicator of lack of health services and proportion of women not using health facilities across the provinces revealed the following results, as shown in Figure 5.14. Lack of health services measured by distance had the lowest rates across the population compared to non-use of maternal health services and poor health status. Notably, both poor health status and non-use of maternal health services were very high across all provinces. The highest was, however, observed in Northern whilst Copper-belt and Lusaka recorded lowest in lack of health services. Central, Western and Southern revealed an association between poor health status and non-use of maternal health services as both indicators had similar proportions.

**Figure 5.14: Comparison of risk factors across the provinces, ZDHS 2007**




Models were fitted to examine the effect of autonomy on place of delivery and assistance during delivery. The two measures of autonomy were significantly related to place of delivery (Model 1 unadjusted). When the control variables were introduced in Model 2, only autonomy over own health remained significant. Relative to those who had more autonomy in decisions which affect their own health, those who had low autonomy were 37 percent more likely to deliver at home (OR 1.37 $p<0.05$). Similarly, the odds ratio of assistance during delivery by unskilled persons, such as traditional birth attendants, was higher for women who had low autonomy in all two indicators of autonomy. Adjusting for the control variables (Model 2), low autonomy over own health significantly affected the likelihood of being assisted during delivery by health professionals (OR 1.35 $p<0.05$).

**Table 5.9: Logistic regression of place of delivery and assistance during delivery on gender inequality and selected aspects of women, ZDHS 2007**

| Variables | Place of Delivery | | Skilled Assistance at Delivery | |
|---|---|---|---|---|
| | Model 1 | Model 2 | Model 1 | Model 2 |
| **Gender Inequality (Autonomy)** | | | | |
| **H/hold Decision Making (More)** | | | | |
| **Low** | 1.40(1.13-1.73)** | 0.89(0.69-1.15) | 1.42(1.14-1.75)** | 0.89(0.69-1.14) |
| **Decision Own Health (More)** | | | | |
| **Low** | 1.39(1.15-1.67)** | 1.37(1.07-1.74)* | 1.37(1.14-1.66)** | 1.35(1.06-1.71)* |
| **Individual Level variables** | | | | |
| **Highest Education (Sec/Higher)** | | | | |
| **Primary** | | 1.56(1.23-1.98)*** | | 1.53(1.21-1.93)*** |
| **No Education** | | 2.84(1.93-4.17)*** | | 2.78(1.89-4.10)*** |
| **Distance Facility (No Problem)** | | | | |
| **Big Problem** | | 1.46(1.10-1.93)** | | 1.44(1.09-1.89)* |
| **Household level variables** | | | | |
| **Wealth Index (Rich)** | | | | |
| **Average** | | 1.99(1.42-2.78)*** | | 2.09(1.53-2.86)*** |
| **Poor** | | 2.44(1.70-3.51)*** | | 2.61(1.83-3.73)*** |
| **Parity (1-2)** | | | | |
| **3-4** | | 1.62(1.22-2.14)** | | 1.54(1.18-2.02)** |
| **5+** | | 1.68(1.21-2.34)** | | 1.63(1.16-2.28)** |
| **Partner's Education (Sec/Higher)** | | | | |
| **No Education/Primary** | | 1.31(1.06-1.61)* | | 1.23(1.00-1.53)* |
| **Community level variables** | | | | |
| **Place of Residence (Urban)** | | 2.84(1.96-4.13)*** | | 2.63(1.85-3.73)*** |
| **Rural** | | | | |
| **Province (Central)** | | | | |
| **Copper-belt** | | 0.44(0.24-0.82)* | | 045(0.25-0.83)* |
| **Eastern** | | 0.29(0.17-0.49)*** | | 0.33(0.19-0.56)*** |
| **Luapula** | | 0.73(0.42-1.27) | | 0.78(0.44-1.36) |
| **Lusaka** | | 0.42(0.25-0.70)** | | 0.44(0.26-0.75)** |
| **Northern** | | 0.64(0.34-1.21) | | 0.72(0.38-1.34) |
| **North-Western** | | 0.36(0.20-0.65)** | | 0.48(0.27-0.85)* |
| **Southern** | | 0.66(0.40-1.10) | | 0.70(0.42-1.16) |
| **Western** | | 0.33(0.19-0.57)*** | | 0.36(0.20-0.63)*** |
| **Constant** | 0.68(0.57-0.81)*** | 0.09(0.04-0.20)*** | 0.73(0.62-0.87)*** | 0.10(0.04-0.22)*** |

***p<0.05 **p<0.01 ***P<0.001 †p<0.10**

Other variables that were significantly related to place of delivery and assistance during delivery included education, distance to health facility, household wealth index, parity, partner's education, place of residence and region. Respondents who said distance to a health facility was a big problem in accessing healthcare had a higher likelihood of delivering at home and receiving assistance from unskilled personnel.

### 5.3.1: Interaction between antenatal visit and use of skilled delivery at birth

Relationship between antenatal care visits and use of skilled personnel at birth was investigated. The proportion of women that were assisted by skilled personnel at delivery increased from as low as 3.98 percent among those who did not have any ANC, to 29.92 percent, 37.35 percent, 47.18 percent and 48.79 percent respectively among those who had one, two, three and four or more ANC visits (Figure 5.3.1.1). The difference between the women who used skilled personnel at delivery among the women who attended 3 visits and 4 or more visits was very minimal. Notably, the low coverage of institutional delivery in the rural area was observed in those women who did not receive any antenatal care as they were unlikely to use skilled delivery at birth. For instance, the data shows that those who did not attend any ANC visits ever used skilled personnel at delivery.

However, for the urban women, those who did not attend any antenatal visits recorded a proportion of 27.05 percent of skilled attendance at birth (Figure 5.16). This increased significantly to 87.65 percent for women with one visit against 3.74 percent for rural women. The same applied for women who had four or more ANC visits as they had 81.29 percent compared to rural women at 33.78 percent. At population level as well as place of residence, having had four or more ANC visits is consistently shown to be associated with the highest use of skilled personnel at birth (Figure 5.15/16).

**Figure 5.15: Percentage distribution of women by ANC visits, ZDHS 2007**

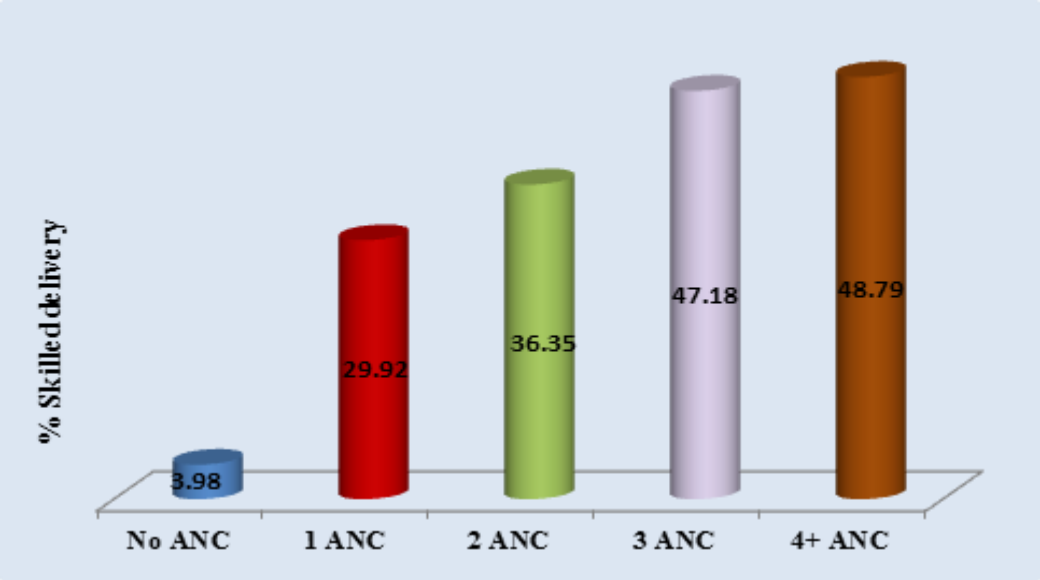



**Figure 5.16: Women's ANC visits and use of skilled delivery by place of residence, ZDHS 2007**


## 5.4 Differentials of pregnancy-related risks using HMIS 2013 and ZDHS 2007

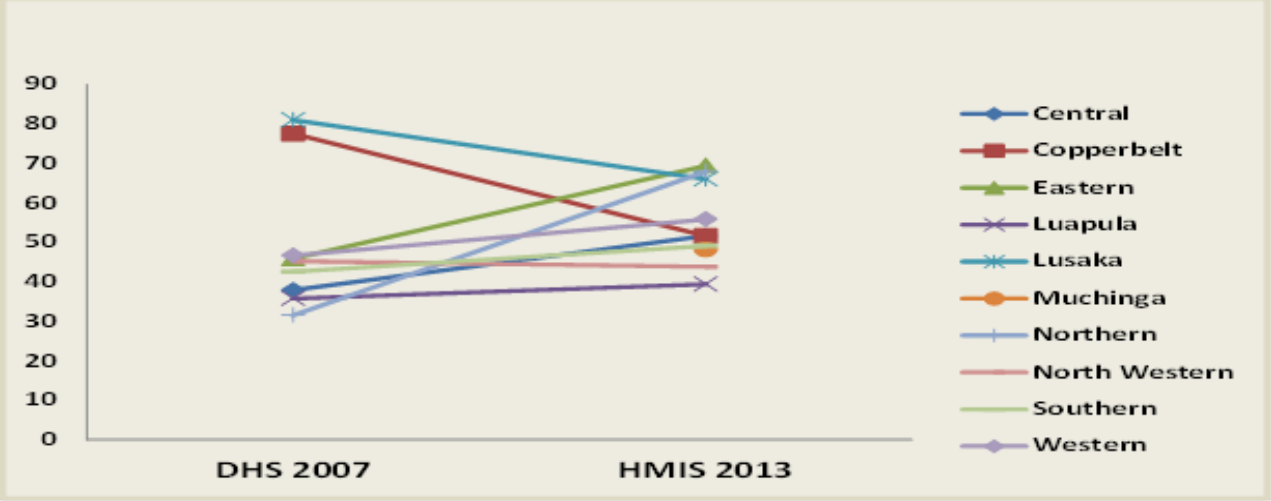
This section utilises two data sets commonly used in Zambia to analyse demographic and social factors that could predispose a woman to the risks of maternal death. Differentials of demographic factors, abortion levels, caesarean section and lifetime risk of maternal death from the two data sets of Zambia are analysed.

### 5.4.1 Differentials of survey and routine data on demographic factors related to maternal risks

Figure 5.17 shows the percentage distribution of women utilising health facilities at birth from the two data sets (HMIS 2013 and ZDHS 2007). Major differences are expected because HMIS is a health facility routine data hence estimates are based on collected data of every woman that delivered from any public health institution whilst the ZDHS is a nationally representative survey hence estimates are based on standardised nationally representative survey data on every woman aged 15 to 49.

Results indicate that the percentage distribution of women who delivered at the health facilities from the DHS dataset was Lusaka (80.97 percent), Copper-belt (77.48 percent), Western (47.65 percent), Eastern (45.87 percent), North-Western (45.23 percent), Southern (42.54 percent), Central (37.9 percent) Luapula (35.77 percent) and Northern (31.53 percent), whilst from the HMIS data the results were as follows: Lusaka (66 percent), Copper-belt (51.6 percent), Western (55.8 percent), Eastern (69.4 percent), North-Western (43.8 percent), Southern (49.1 percent), Central (51.6 percent) Luapula (39.4 percent), Northern (67.9 percent) and Muchinga (48.2 percent).

**Figure 5.17: Comparison of percentage distribution of institutional deliveries – ZDHS and HMIS**

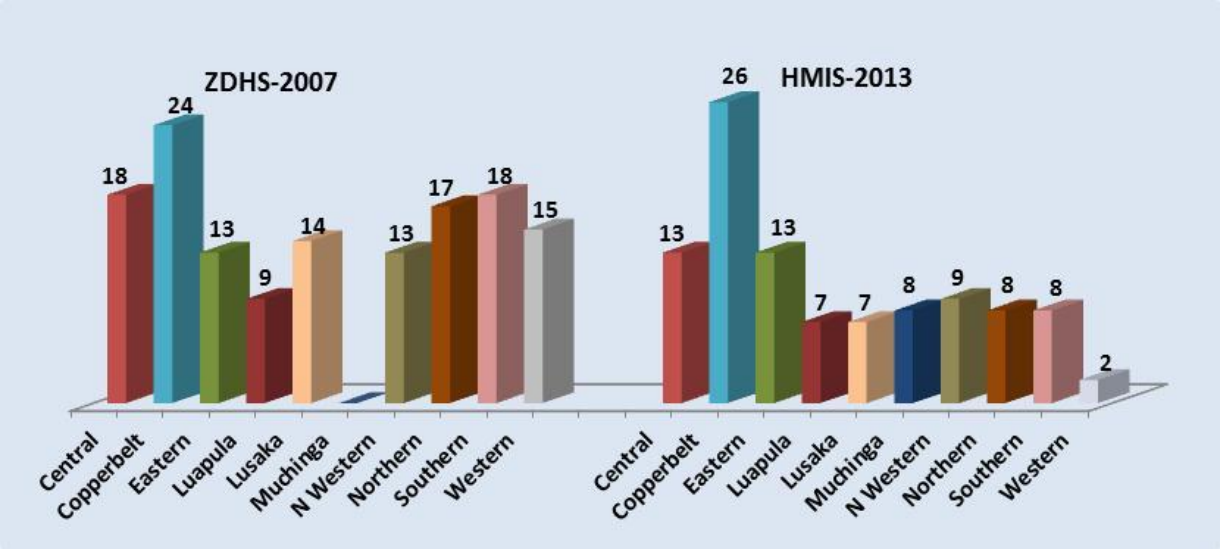


### 5.4.2 Differentials of abortion rate by two data sets – ZDHS and HMIS

Risky abortion is an important contributor to the high maternal mortality in any country. Adverse reactions of risky abortion are one of the many contributors to MMR. Incidence of risky abortion mostly reflects the significance of unwanted pregnancies in any particular neighbourhood. Risky abortion can be adequately reduced by ensuring women have easy access to contraceptive services, backed up by a proper framework that facilitates safe abortion. This section therefore analyses the magnitude of risky abortion using information from HMIS of women who delivered at the health facility and the DHS survey.

Figure 5.18 presents the comparison of percentage distribution of abortion by the two data sets. Information from the two data sets in the provinces reveals similar depiction of abortion levels except from three rural provinces where the differences were very wide. For example, Central, Copper-belt, Lusaka and Southern showed similar magnitude of abortion in both data sets, whilst Eastern, Northern and Western provinces had wider differentials. Information from HMIS showed that abortion was very high in Eastern Province whilst DHS recorded a much smaller percentage. In Northern Province, the picture shows that abortion was low as captured by HMIS whilst DHS indicated a higher range. The same applies to Western Province. Muchinga Province is a new province, so it was not captured in the ZDHS 2007, and only appears in the HMIS. When we compare the provinces according to the data set, results indicate that for the ZDHS, Copper-belt, Central and Southern recorded the highest percentages of women who had abortions, whilst for HMIS, Copper-belt, Central and Eastern had the highest. However, it must be noted that there were great differentials in the two data sets concerning Southern Province as DHS recorded very high percentages whilst HMIS recorded amongst the lowest. Figure 5.18 displays the discrepancies. HMIS captures data on adverse reactions during abortion regarding women who deliver at the health facility or who report at the facility, hence there is a high possibility of omitting information on women who abort at home or unreported cases.

**Figure 5.18: Differentials of abortion levels – ZDHS and HMIS**



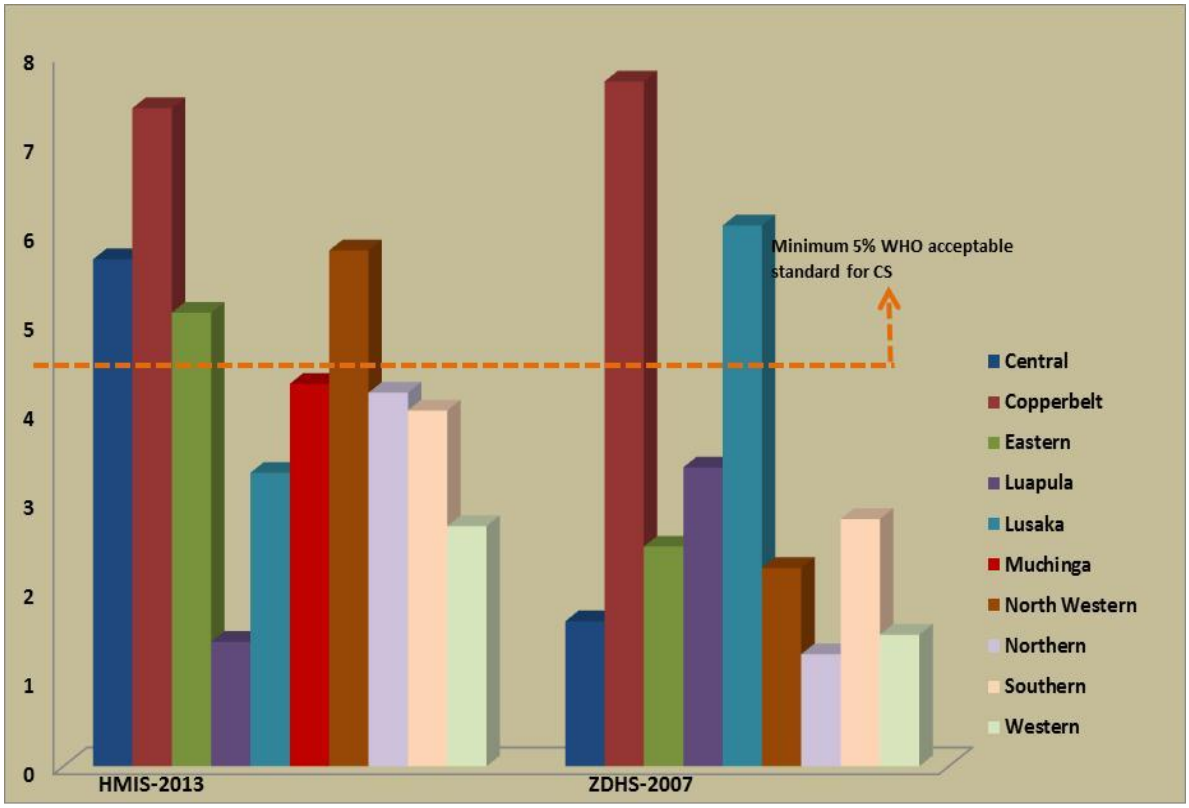

## 5.5 Differentials of delivery through caesarean section by ZDHS and HMIS

Caesarean delivery without medical indication is associated with an increased risk of adverse short-term maternal outcomes. Caesarean delivery is often used as a lifesaving process, especially when adverse reactions arise. The World Health Organisation set an expected standard of 5 to 15 percent of caesarean sections as an indication of the use of skilled attendance, a process by which a pregnant woman is given EOMC (WHO, 2009). Some studies have shown that low-income countries lacking EOMC having low rates of CS below the set standard and have high maternal and neonatal mortality. Elsewhere, high rates of CS have not shown any added benefit for the mother or her infant, only being linked to negative consequences in maternal and child health (Gibbons et al., 2010).

This section compares the rate of caesarean section performed on women in each province as indicated by ZDHS and HMIS. Figures 5a and b compare the two data sets. Wider differentials were observed on the levels of caesarean section by women according to the HMIS and DHS data. For instance, for both data sets, Copper-belt recorded high levels of use of C-section whilst Western recorded lower levels as indicated by the two data sets. For Lusaka and Northern, the differential was very pronounced as HMIS indicated

low levels whilst DHS indicated very high levels. For Northern it was the opposite as HMIS indicated high levels whilst the picture portrayed by DHS was of low usage. Overall, only Western Province recorded low levels of C-section from the two data sets. From the two datasets as indicated in Figure 5.19 four provinces from HMIS (Central, Copper-belt, Eastern and North-Western) and two provinces from ZDHS (Copper-belt and Lusaka), achieved the WHO minimum standard (WHO, 2009).

**Figure 5.19: Differentials of Caesarean Section-ZDHS and HMIS**




## 5.6 Differentials of lifetime risk of maternal death

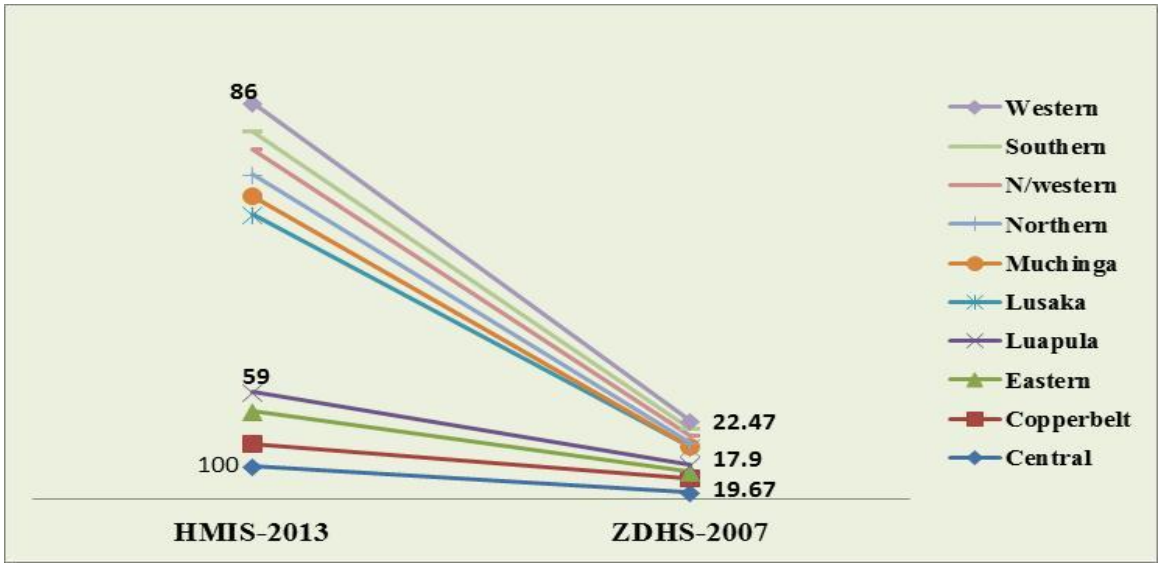
Maternal mortality is one of the major challenges to health systems in sub-Saharan Africa. Despite challenges of measuring maternal mortality, the need for monitoring of maternal mortality is a priority for almost all countries.

A number of countries are now strengthening their efforts to improve the quality of information about maternal mortality by incorporating various data sources on maternal health. However, maternal mortality

remains a public health issue that shows wide poor-rich disparities between and within countries and regions with almost 99 percent of maternal deaths occurring in low- and middle-income countries. This discrepancy is most obvious when analyzing the lifetime risk for maternal death (Mumtaz et al. 2012).

This section compares the estimates of lifetime risk of maternal death in all the provinces of Zambia using data from the 2007 DHS and 2013 HMIS. Lifetime risk of maternal death using ZDHS was computed using estimates of maternal mortality ratio using the MDRFI model. The information is shown in Figure 5.20. From both data sets lifetime risk for maternal death was recorded lowest in Lusaka Province. In all the provinces lifetime risk of maternal death was lowest from the HMIS compared to DHS. Although from ZDHS, Central and Northern and North-Western provinces had the highest lifetime risk, while from HMIS Luapula and Muchinga recorded the highest lifetime risk of death. For instance, 1 in every 20 women compared to 1 in every 100 women would be at risk in Central province from the DHS and HMIS data respectively. The overall representation portrayed is that lifetime risk in rural provinces is higher in all the data sets compared to the urban provinces. However, surprising results were observed on estimates from HMIS where Copper-belt Province was third highest in the country compared to lifetime risk estimates from ZDHS where Copper-belt was the second least highest.

**Figure 5.20: Differentials of lifetime risk of maternal death, HMIS 2013 and ZDHS 2007**



## Chapter Six - Micro and Macro Level Determinants of Maternal Mortality

### 6.0 Introduction

This chapter addresses the second objective which seeks to assess whether neighbourhood factors have a stronger influence on maternal mortality than individual factors and the extent to which differentials are present in provincial patterns of maternal mortality risks in Zambia.

In this section we analyse the risks of maternal mortality using three variables. Firstly the main dependent variable, high risk pregnancy (HRP), secondly the components forming the outcome variable (short birth interval i.e. having 3+ children under five at birth and risky maternal age i.e. maternal age less than 19 years or aged 35 or above and 3+ children ever born), were assessed as independent risk factors to compare their neighbourhood effect with exposure to high risk pregnancy. One component, Children ever Born (CEB), was dropped as a single component because the random effect and confidence interval were undetectable.

To achieve the abovementioned objectives, the multilevel modelling strategy was applied to build multilevel logistic regression models in the investigation of risks of maternal mortality in Zambia. Five models were fitted. The first model, which is known as the 'null' model, was fitted without explanatory variables. It only includes a random intercept and permitted the observation of the possible presence of a neighbourhood dimension for this phenomenon. The null model (model 1) enabled the assessment of the extent of differences in the outcome variable across neighbourhoods.

The second model (Model 2) included only the individual-level factors. This is to investigate the extent to which area level differences of exposure to high risk pregnancy were explained by the individual composition of the areas. In Model 3 only neighbourhood variables were included in order to investigate whether the neighbourhood phenomenon was conditioned by specific area aspects. Model 4 included both the neighbourhood and individual variables. Thus model 4 investigated the attributes of the socioeconomic and demographic effect of the neighbourhood on exposure to high risk pregnancy

and investigated the extent to which neighbourhood factors moderate the association between individual factors and maternal mortality risks. The final model (Model 5) was used to estimate whether neighbourhood factors moderated the association between individual-level variables and exposure to high risk pregnancy. This model included both individual and neighbourhood variables and a cross-level interaction between women's education and marital status.

The random intercept model was used to investigate whether neighbourhoods differ in average outcomes after controlling for the aspects of individual level exposure to risk of adverse pregnancy outcome within them. The fixed effects (measures of association) are expressed as odds ratio (OR) and related 95 percent confidence intervals (95 percent CI). The random effects (measures of differential) are expressed as variance partition coefficient (VPC), Median Odds Ratio (MOR) and Proportional Change in Variance (PCV). The variance partition coefficient measures the clustering of exposure to risk of adverse pregnancy outcome among individuals, i.e. the extent to which neighbourhoods resemble each other more than they resemble individuals from other neighbourhoods in relation to exposure to risk of adverse pregnancy outcome. The proportion of the variance at the neighbourhood level to the sum of variance is known as the intra-class correlation coefficient (ICC). The ICC is an important tool for assessing the extent of uniformity within units such as families or neighbourhoods (Twisk 2006). To provide a clearer interpretation of neighbourhood variance, we calculated MOR in addition to ICCs.

Given that the outcome variable is binary, we calculated the intra-neighbourhood similarity coefficient based on the linear threshold model method, which converts the individual-level variance from the likelihood proportion to the logistic proportion, on which the neighbourhood variance is expressed. In this case, the individual-level variance is equal to $\pi^2/3$ (3.29) (Snijders & Bosker 1999). Precision was measured by the standard error (SE) of the predictor variables, while parameters were tested using the probability ratio test. An Inter-class Correlation index (Merlo et al. 2006) was used to quantify the neighbourhood contextual effects on the exposure to risk of adverse pregnancy outcome whilst the

Regression diagnostic AIC (Akaike Information Criterion) was used to determine the suitability of the model

$$\textbf{ICC} = \frac{\sigma^2_{u0}}{\sigma^2_{u0} + \pi^2/3}$$

where $\mathbf{A^2_{uo}}$ is the variance between neighbourhoods, and $\pi^2/3$ represents an approximation of the variance between individuals from the same neighbourhood. A large VPC value (close to 1) would indicate maximally segregated clusters, while a low VPC value (close to zero) would suggest homogeneous high risk pregnancy among clusters. Many have debated that multilevel modelling is not essential if ICC is sufficiently close to zero, as this implies that individuals are statistically independent. Nonetheless, precisely how close to zero is 'sufficiently close' depends on several factors, and values of ICC as little as 0.05 can invalidate hypotheses tests and confidence intervals when multilevel modelling is not used. Moreover, there are benefits to the use of multilevel modelling even when the ICC is close to zero (Hayes 2006).

On the other hand, the MOR depends directly on the area-level variance and can be computed with the following formula:

$$\textbf{MOR} = \exp[\sqrt{(2 \times \tau^2)} \times 0{:}6745] \approx \exp(0.95\sqrt{\tau^2})$$

where $\tau^2$ is the area level variance, and 0.6745 is the 75$^{th}$ percentile of the cumulative dispersion function of the normal distribution with mean 0 and variance 1. If the MOR is equal to one, in this case there would be no differences between areas in the probability of exposure to high risk pregnancy. If there were strong area-level differences, the MOR would be large and the area of residence would be pertinent for grasping differentials of the individual probability of exposure to high risk pregnancy.

Neighbourhood differences in exposure to high risk pregnancy in this study may be attributable to contextual influences or to differences in the individual composition of neighbourhoods in terms of all individual variables. By adjusting for individual-level variables we take into account part of the

compositional differences and explain some of the neighbourhood variance detected in the null model (Merlo et al. 2006). The equation for the proportional change in variance (PCV) of the neighbourhood can be written like this:

$$PCV = \frac{V_{n-1} - V_{n-2}}{V_{n-1}}$$

where $V_{n-1}$ is the neighbourhood variance in the null model and $V_{n-2}$ is the neighbourhood variance in the model including individual aspects. The follow-up models can be calculated as the variance of the initial model by the variance of the succeeding model.

To further estimate neighbourhood differential in exposure to high risk pregnancy, neighbourhood residuals, standard errors and ranking with 95 percent confidence intervals for a particular neighbourhood were plotted for each indicator of exposure to high risk pregnancy. From the dataset, 319 residuals were plotted, one for each cluster or neighbourhood according to their ranking with their confidence intervals. The vertical lines on the graphs below represent the confidence intervals and smaller neighbourhoods tend to have wider confidence intervals. When the confidence intervals overlap the zero horizontal line, it indicates exposure to high risk pregnancy (high risk pregnancy, short birth interval, and risky maternal age) in that particular neighbourhood is not significantly different from the overall mean risks high risk pregnancy in the country. If the confidence interval is below the zero line, exposure to risks high risk pregnancy is significantly lower for that neighbourhood, and if the confidence interval is above the zero line, exposure to risks high risk pregnancy is significantly higher for that neighbourhood. However, if the confidence interval overlaps the zero line, it means that exposure to risks high risk pregnancy for that neighbourhood does not significantly differ from the mean exposure to high risk pregnancy in the country. The graphs (caterpillar plot) for each of the indicators of exposure to the risk of high risk pregnancy are presented in Figures 6.2, 6.4, and 6.7.

## 6.1 Independent effects of neighbourhood factors and moderating effects on the association between individual factors and exposure to high risk pregnancy (HRP)

This sub-section presents the independent effects of neighbourhood factors on the exposure to high risk pregnancy, as well as the moderating effects of neighbourhood factors on the relationship between individual-level factors and the outcome variable.

The results from Table 6.1 indicate that the test statistic was $\tau = .041997$, $p<0.001$, hence there is evidence that between neighbourhood variance is non-zero. In the Null model (Model 1), 5 percent of the variance in exposure to HRP at individual level could be attributed to neighbourhood level. This differential decreased after adjusting for individual (Model 2), neighbourhood aspects (Model 3) and two-level factors of individual and neighbourhood (Model 4) to 2 percent, 2 percent and 1 percent respectively. In the final model, which included two-level aspects and their interactions (Model 5), the intra-neighbourhood correlation was maintained at 1 percent. The results of the model adjusted by individual level aspects only (Model 2) showed a HRP significantly associated with married women (AOR= 1.76, 95 percent CI: 2.97–18.67) and the formerly married (AOR 2.59; CI 95 percent: 2.97–18.67).

The median of these odds ratios between women living in the neighbourhood with the higher tendency of exposure to high risk pregnancy and women living in the neighbourhood with the lower propensity is estimated to be 1.23 in Model 1. This is a low-odds ratio, and it suggests that the clustering effect is minimal even without adding any cluster-level covariates. When individual-level aspects are included (Model 2), the undetermined cluster diversity (comparing persons from neighbourhoods of the same kind) decreases. This yields an MOR of 1.18, which is still a very low odds ratio. When neighbourhood aspects (model 3), individual and neighbourhood (module 4) and all factors including cross level are included, an MOR of 1.19, 1.14 and 1.15 are yielded respectively. Evidently, there is very little differential between neighbourhoods in the propensity for exposure to high risk pregnancy.

The contextual aspects at neighbourhood level associated with HRP as presented in Model 3 indicate that the higher the neighbourhood level of education the less the odds of exposure to high risk pregnancy. High neighbourhood level of education had reduced odds (AOR= 0.699, 95 percent CI: 0.63-.95) and medium neighbourhood level of education (AOR= 0.792, 95 percent CI 0.49-1.04). Rural neighbourhood had higher odds of exposure to high risk pregnancy compared to urban neighbourhood (AOR =1.4, 95 percent CI: 1.2-1.74). Health facility delivery had reduced odds (AOR= 0.844 95 percent CI: 0.72-.97) compared to delivery at home. Region of residence had a significant association with exposure to high risk pregnancy as residing in Luapula and North-Western had increased odds at AOR=1.028, 95 percent CI: 1.73-2.44 and AOR=1.103, 95 percent CI:1.78-1.55 respectively, whilst women from Lusaka Province had reduced odds (AOR= 0.896, 95 percent CI:0.69-.93) compared to the base category central province. Other provinces had no significant association with exposure to high risk pregnancy.

Model 4, adjusted by individual and neighbourhood aspects, shows a significant association between neighbourhood place of delivery, in that women from neighbourhoods who utilised health facilities at delivery had reduced risks (AOR= 0.769, CI 95 percent: 0.65-0.94) compared to women in neighbourhoods who delivered at home. The odds of exposure to high risk pregnancy by women with secondary and higher education was 0.69 times lower than women with no education. Other predicators of exposure to high risk pregnancy were women's marital status. The formerly and married women had higher odds of exposure to high risk pregnancy compared to the never married. Additionally, an interaction between the individual wealth status and neighbourhood wealth status was found, for each increase in individual wealth status the less the chances of exposure to high risk pregnancy (AOR= 0.748, 95 percent CI: 0.72-0.99) in individuals of high wealth status (AOR=0.873, 95 percent CI: 0.55-0.99).

The last model included a cross-level interaction of education with marital status. Marital status, educational level, wealth status, neighbourhood place of delivery, individual and neighbourhood place of residence maintained a statistical significance even after adding the cross-level variable. Education proved

to show a statistical significance over marital status. Regardless of marital status, behaviour of education across marriage in the neighbourhoods was statistically significant, with women with no education regardless of their marital status having higher odds of exposure to high risk pregnancy compared to women with primary and secondary education. This indicates that education has an independent effect on exposure to high risk pregnancy, over and above the well-known effects of marital status.

**Table 6.1 Multilevel logistic regression odds ratio of the effects of individual/community factors on high risk pregnancy, CSO, 2009**

| Variable | Model 1 (Empty) | Model 2 Individual | Model 3 Community | Model 4 Individual and community | Model 5 Highest education x marital status |
|---|---|---|---|---|---|
| **Fixed effects** | | **Odds Ratio** | **Odds Ratio** | **Odds Ratio** | **Odds Ratio** |
| **Individual characteristics** | | | | | |
| **Marital Status** | | | - | | |
| Never Married | | 1.000 | - | 1.000 | 1.000 |
| Currently Married | | 1.763*** | - | 1.774*** | 1.785*** |
| Formerly Married | | 2.599*** | - | 2.606*** | 2.397*** |
| **Highest Level of Education** | | | - | | |
| No Education | | 1.000 | - | 1.000 | 1.000 |
| Primary | | .835 | - | .832* | .829 |
| Secondary/Higher | | .444*** | - | .435*** | .551*** |
| **Wealth Status** | | | - | | |
| Poor | | 1.000 | - | 1.000 | 1.000 |
| Average | | .889* | - | .873* | .900* |
| Rich | | .816* | - | .748** | .799* |
| **Place of Residence** | | | - | | |
| Rural | | 1.000 | - | 1.000 | 1.000 |
| Urban | | .775** | - | .831 | .785* |
| **Distance to Health Facility** | | | - | | |
| No Problem | | 1.000 | - | 1.000 | 1.000 |
| Problem | | 1.065 | - | 1.059 | 1.055 |
| **Community Characteristics** | | - | - | | |
| **Community Education** | | - | | | |
| Low | | - | 1.000 | 1.000 | - |
| Medium | | - | .792* | .919 | |
| High | | - | .699* | .923 | |
| **Employment Level** | | - | | | |
| Low | | - | 1.000 | 1.000 | 1.000 |
| Medium | | - | 1.13 | 1.111 | 1.121 |
| High | | - | 1.07 | 1.122 | 1.158 |
| **Place of Residence** | | - | | | |
| Urban | | - | 1.000 | 1.000 | 1.000 |
| Rural | | - | 1.4*** | 1.169 | .771** |
| **Place of delivery** | | - | | | |
| Home | | - | 1.000 | 1.000 | 1.000 |
| Health facility | | - | .844* | .769*** | .800** |

| | | | | | |
|---|---|---|---|---|---|
| **HIV risk Assessment** | - | | | | |
| Low | - | 1.000 | 1.000 | 1.000 | |
| Medium | - | 1.11 | 1.046 | 1.182 | |
| High | - | 1.11 | .990 | 1.203 | |
| **Awareness Maternal Educ.** | - | | | | |
| Low | - | 1.000 | 1.000 | 1.000 | |
| Medium | - | .984 | 1.069 | 1.084 | |
| High | - | .824 | 1.052 | 1.095 | |
| **Region** | | | | | |
| Central | | 1.000 | 1.000 | 1.000 | |
| Copper-belt | | 1.274 | 1.219 | 1.147 | |
| Eastern | | .879 | .839 | .787 | |
| Luapula | | 1.028* | .986* | .958* | |
| Lusaka | | .896* | .859* | .852* | |
| Northern | | 1.010 | .995 | .982 | |
| North-Western | | 1.103* | 1.036* | 1.00* | |
| Southern | | 1.033 | .999 | .990 | |
| Western | | .726 | .800 | .804 | |
| **Highest Educ. x marital status** | | | | | |
| None x Never married | | | | 1.000 | |
| Primary x currently married | | | | .315** | |
| Sec/higher x currently married | | | | .337** | |
| Primary x formerly married | | | | .228** | |
| Sec/higher x formerly married | | | | .277** | |
| **Random effects Parameters** | **Empty** | **Individual** | **Community** | **Individual & community** | **Individual & community X cross level** |
| Variance (SE) | .041997 | .0313513 | .030196 | .0294207 | .0305103 |
| VPC=ICC (%) | 0.048 | 0.0155 | 0.0158 | 0.011 | 0.013 |
| PCV (%) | Reference | 25.3 | 28.1 | 29.9 | 27.4 |
| ***Log-Likelihood*** | -2836.511 | -2718.513 | -2794.999 | -1627.136 | -2712.753 |
| ***Model fit statistics*** | | | | | |
| AIC | 5677.023 | 5457.027 | 5617.998 | 3298.272 | 5459.507 |
| BIC | 5689.805 | 5520.936 | 5707.472 | 3438.873 | 5568.153 |
| Lr test model 1 nested | - | - | -152.97 | 53.32*** | 11.52 |
| Lr test null model nested | - | 236 **** | 83.2*** | 250.55*** | 252**** |

The null model contains no variables but partitions the variance into two parts SE = Standard error, VPC= Variance Partition Coefficient, PCV = Proportional Change in Variance, AIC=Akaike information criterion, BIC = Bayesian information criterion - Significance level *p<0.05.

Figure 6.1 shows the percentage distribution of inter-class correlation (ICC), median odds ratio (MOR) and proportion change in variance (PCV) in relation to exposure to high risk pregnancy. Inter-class correlation is important because it helps to express the similarity in exposure to high risk pregnancy rate between two women living in the same neighbourhood. An ICC equal to 1 would show that all the women in a

neighbourhood have an identical rate of exposure to high risk pregnancy (that is, 100 percent of the total individual differences are at neighbourhood level), and an ICC equal to 0 would show that the individuals do not share any neighbourhood-related common level of exposure to high risk pregnancy. A high ICC value would show that neighbourhoods are very important in comprehending individual differentials in health. Otherwise, an ICC of 0 would suggest that the neighbourhood effect is similar to that of random samples taken from the entire population and suggests that neighbourhood is not relevant to understanding differences in the proportions of exposure to high risk pregnancy. When the ICC is 0, the appropriateness of performing a multilevel analysis is to a lesser extent evident (Merlo et al. 2006). When a multilevel structure is lacking, a single-level individual analysis is appropriate.

Our results showed that ICC ranged from 4.8 (Null model) to 1.6 (individual aspects), 1.6 (neighbourhood aspects), 1.1 (both individual and neighbourhood) and 1.3 (full model with cross-level variable). The intra-class correlation at all levels was small, indicating that most of the differential in the models is explained by individual-level aspects. This has also been showed by the results of MOR which are significantly small, indicating very little differential between neighbourhoods in the propensity for exposure to high risk pregnancy. The inclusion of individual and neighbourhood covariates further reduced the differential explained by unobserved neighbourhood aspects of exposure to high risk pregnancy. Since the outcome variable (high risk pregnancy) was a composite of risky maternal age, a proxy for being young (15 to 19) or very old (35 years or older); short birth interval; a proxy for having three or more children under five years at the time of birth, further analysis was done separately on each component of high risk pregnancy as independent risk factors to assess the influence of neighbourhood effect.

**Figure 6.1: Percentage distribution of ICC and PCV**

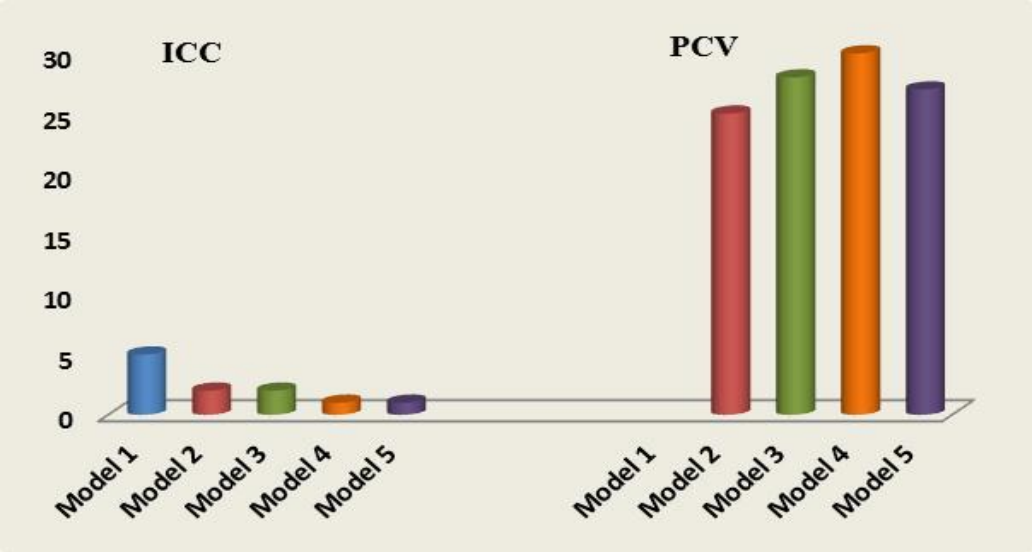
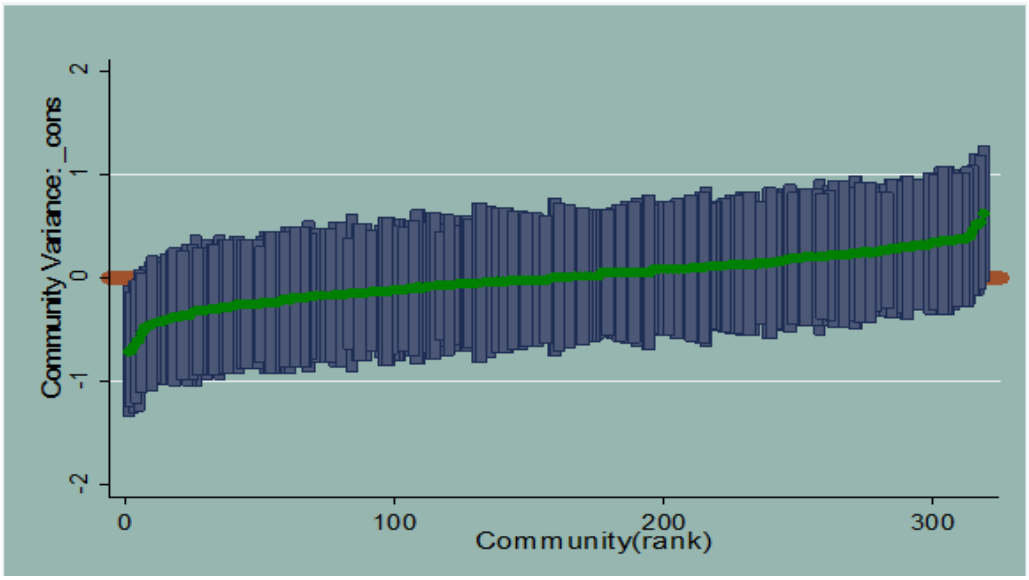



Figure 6.2 shows the plot of the estimated residuals for all 319 neighbourhoods in the sample. For the outcome (exposure to high risk pregnancy), the first caterpillar plot in Figure 6.3 shows how far the average exposure to high risk pregnancy of each woman in the neighbourhood deviates from the average exposure to high risk pregnancy across all neighbourhoods in the sample (that is, the grand mean). The grand mean is represented by the horizontal zero line across the caterpillar plot. A neighbourhood whose confidence interval does not cross the horizontal zero line has an average outcome that is significantly different from the grand mean. Each neighbourhood in the plot features 95 percent confidence intervals, which captures the range of prediction error. The size of prediction error reduces as the amount of women per neighbourhood in the sample increases and vice versa. In this study, most neighbourhood residuals contain zero within their 95 percent confidence interval. This implies that these neighbourhoods do not show significant differences in exposure to high risk pregnancy from the overall mean predicted by the fixed part of the model. Although there are a few neighbourhoods whose remaining areas (residual) show the highest negative deviations, it can be concluded that such few neighbourhoods perform below average with respect to exposure to high risk pregnancy.

**Figure 6.2 Neighbourhood variance (residual), standard error and ranking with 95 percent confidence interval for high risk pregnancy**




**6.2: Independent effects of individual and neighbourhood factors on having three or more children under five at time of birth**

This section presents the effects of individual and neighbourhood level factors on exposure to risk due to short birth interval at time of delivery. The variance component model is a null model without any explanatory variables but only estimates individual and neighbourhood differences in exposure to high risk pregnancy. In this model, the differentials in exposure to having three or more children under five between individuals are assumed to be of similar magnitude for every neighbourhood. In using this model, we simply aim to identify a possible neighbourhood phenomenon that can be quantified by autocorrelation of having three or more under five children at birth within individuals (Merlo et al., 2005). The total variance is partitioned to provide an estimate of intra-class correlation coefficient (ICC), median odds ratio (MOR) or variance partition coefficient (VPC), as shown in figure 6.1.

The median of these odds ratios between the women living in the neighbourhood with the higher tendency of exposure to maternal mortality risks due to pregnancies of short birth interval and women living in the

neighbourhood with lower tendency, is estimated to be 2.18 in Model 1. This is a high-odds ratio, suggesting that the heterogeneity is substantial. Including individual variables (Model 2), neighbourhood variables (model 3), individual and neighbourhood (module 4) and all factors including cross level, yields an MOR of 1.91, 1.86 and 1.91 respectively. Though it is decreasing, the MOR is still high. Thus, the propensity to exposure to maternal mortality risks due to short birth interval varies a great deal between neighbourhoods. The results of MOR are in line with what has been found with the ICC values.

Results in the null model showed a significant amount of differential in the likelihood of having three or more children less than five years at the time of delivery across neighbourhoods. Based on the differential partition coefficient (VPC) values, 17 percent of the total variance in having three or more children less than five years at the time of delivery was attributable to the differences across neighbourhoods. This differential was significant ($\tau = .128595$, $p = 0.000$).

Individual-level factors were introduced in Model 2, and their slopes were allowed to vary in order to investigate whether their effects are different across contexts. Increasing wealth status was significantly associated with reduced odds of having three or more children under five (AOR = 0.7481, 95 percent CI = .637-.976) compared with the women from the poor category. Women who resided in the urban area had reduced odds of having more than three children in less than five years (AOR=0.559, 95 percent CI =.382-.815) compared to their counterparts residing in rural areas. In comparison to the null model, the differential in having three or more children under five years old at birth in Model 2 remained significant across neighbourhoods. The intra-neighbourhood correlation decreased to 14 percent. The proportional change in variance of the odds of having three or more children under five years old of 12.4 percent across neighbourhoods was explained by individual-level compositional factors and indicates that part of the clustering of having three or more children in less than five years is due to composition of the neighbourhoods by individual level.

With the introduction of neighbourhood variables only in Module 3, the likelihood of having three or more children under five at birth was increased for women in rural neighbourhoods (AOR=1.67, 95 percent CI=1.182-2.356) compared to women from urban neighbourhoods. Women residing in Northern Province had reduced odds of 42 percent compared to women residing in Central Province.

The combination of individual and neighbourhood factors in Module 4 showed that VPC was still appreciably above zero; indicating that even after controlling for individual and neighbourhood factors, there was a considerable clustering of having three or more children under five at neighbourhood and individual level. At neighbourhood level, rural residence was found to be positively associated with 1.64 times increased odds of having three or more children under five at birth. Women residing in Western Province had a reduced chance of 62 percent in having three or more children under five at time of delivery (AOR=0.383 95 percent CI: 0.204-0.719) compared to women from Central Province.

Model 5 included a cross-level interaction of education on marital status. Wealth status and place of residence maintained a statistical significance, even after adding the cross-level variable. Surprisingly, HIV risk assessment was now of statistical significance as it has not been significant in the whole analysis. High neighbourhood HIV risk assessment was increasingly associated with having three or more children under five at birth (AOR=1.62 95 percent CI: 1.14-2.33) compared to neighbourhoods with low HIV risk assessment.

The interaction between education and marital status in having three or more children at birth had no effect since women with post primary education but formerly married had higher odds of having three or more children under five (AOR=1.02 95 percent CI: 0.17-.94) compared to women with no education and who never married.

**Table 6.2: Multilevel Logistic regression odds ratio of the effects of individual and neighbourhood factors on exposure risk due to short birth interval, ZDNS 2007**

| Variable | Model 1 (Empty) | Model 2 Individual | Model 3 Community | Model 4 Individual and community | Model 5 Individual and community with cross level interaction |
|---|---|---|---|---|---|
| **Fixed effects** | | **Odds Ratio** | **Odds Ratio** | **Odds Ratio** | **Odds Ratio** |
| Individual characteristics | | | | | |
| **Marital Status** | | | - | | |
| Never Married | | 1.000 | - | 1.000 | 1.000 |
| Currently Married | | .953 | - | .976 | 1.115 |
| Formerly Married | | 1.00 | - | 1.034 | 1.466 |
| **Highest Level of Education** | | | - | | |
| No Education | | 1.000 | - | 1.000 | 1.000 |
| Primary | | 1.258 | - | 1.253 | 1.77 |
| Secondary/Higher | | 1.112 | - | 1.128 | 1.279 |
| **Wealth Status** | | | - | | |
| Poor | | 1.000 | - | 1.000 | 1.000 |
| Average | | .913 | - | .916 | .919 |
| Rich | | .748* | - | .721 | .671** |
| **Place of Residence** | | | - | | |
| Rural | | 1.000 | - | 1.000 | 1.000 |
| Urban | | .559*** | - | .675 | .564*** |
| **Distance to Health Facility** | | | - | | |
| No Problem | | 1.000 | - | 1.000 | 1.000 |
| Problem | | .968 | - | .965 | .963 |
| **Community Characteristics** | | | - | | |
| **Community Education** | | | - | | |
| Low | | | 1.000 | 1.000 | 1.000 |
| Medium | | | .906 | .906 | - |
| High | | | .647 | .671 | |
| **Employment Level** | | | | | |
| Low | | | 1.000 | 1.000 | 1.000 |
| Medium | | | 1.265 | 1.211 | 1.244 |
| High | | | 1.152 | 1.156 | 1.211 |
| **Place of Residence** | | | | | |
| Urban | | | 1.000 | 1.000 | 1.000 |
| Rural | | | 1.67*** | 1.644** | |
| **Place of delivery** | | | | | |
| Home | | | 1.000 | 1.000 | 1.000 |
| Health facility | | | 1.23 | 1.204 | 1.268 |
| **HIV risk Assessment** | | | | | |
| Low | | | 1.000 | 1.000 | 1.000 |
| Medium | | | 1.153 | 1.164 | 1.238 |
| High | | | .831 | 0.822 | 1.624** |
| **Awareness Maternal Educ.** | | | | | |
| Low | | | 1.000 | 1.000 | 1.000 |
| Medium | | | 1.118 | 1.168 | 1.115 |
| High | | | .882 | 1.033 | .979 |
| **Region** | | | | | |

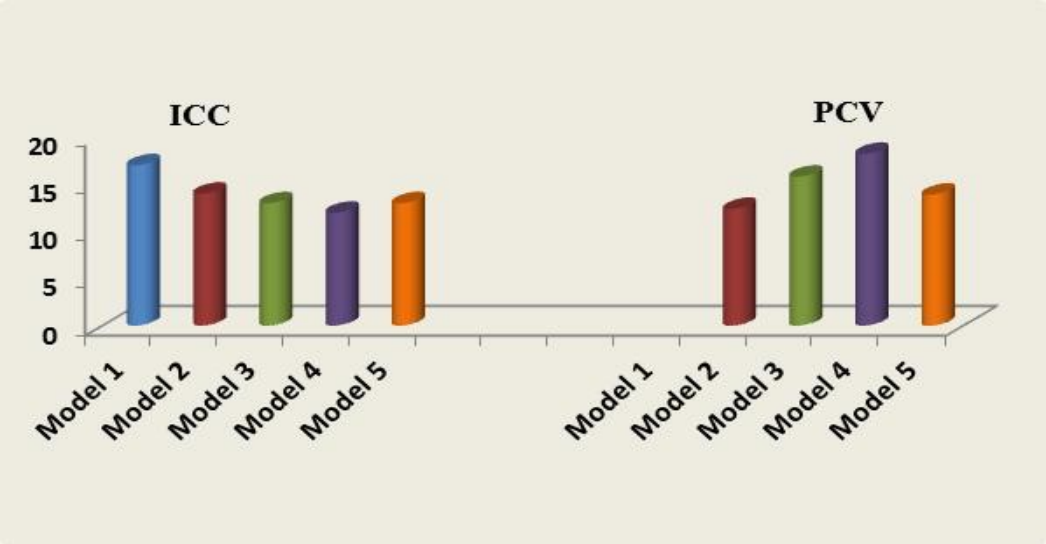
| | | | |
|---|---|---|---|
| Central | 1.000 | 1.000 | 1.000 |
| Copper-belt | 1.357 | 1.363 | 1.302 |
| Eastern | .653 | .669 | .656 |
| Luapula | 1.170 | 1.134 | 1.114 |
| Lusaka | .695 | .697 | .747 |
| Northern | .577* | .583 | .649 |
| North-Western | 1.326 | 1.257 | 1.270 |
| Southern | 1.296 | 1.254 | 1.259 |
| Western | .389** | .383** | .449** |
| **Educ. x marital status** | | | |
| None x Never married | | | 1.000 |
| Primary x currently married | | | .696 |
| Sec/higher x currently married | | | .839 |
| Primary x formerly married | | | .505 |
| Sec/higher x formerly married | | | 1.015** |

| **Random effects Parameters** | **Empty** | **Individual** | **Community** | **Individual & community** | **Individual & community cross level interaction** |
|---|---|---|---|---|---|
| Variance (SE) | .128595 | .1127029 | .1083136 | .1051689 | .1080923 |
| VPC=ICC (%) | 17 | 14 | 13 | 12 | 13 |
| PCV (%) | Ref | 12.4 | 15.8 | 18.2 | 13.9 |
| ***Log-Likelihood*** | -1653.795 | -1635.892 | -1632.516 | -1627.136 | -1629.1838 |
| ***Model fit statistics*** | | | | | |
| AIC | 3311.591 | 3291.785 | 3293.032 | 3298.272 | 3292.368 |
| BIC | 3324.372 | 3355.694 | 3382.505 | 3438.873 | 3401.014 |
| LR test | | | 55.59*** | 46.33*** | 55.81*** |
| Lr test | - | - | 6.75 | 17.52 | 13.42* |
| Lr test null model nested | - | 35.81*** | 42.56*** | 53.32*** | 51.73*** |

The null model contains no variables but partitions the variance into parts SE = Standard error, VPC= Variance Partition Coefficient, PCV = Proportional Change in Variance, AIC=Akaike information criterion, BIC = Bayesian information criterion Significance level *p<0.05

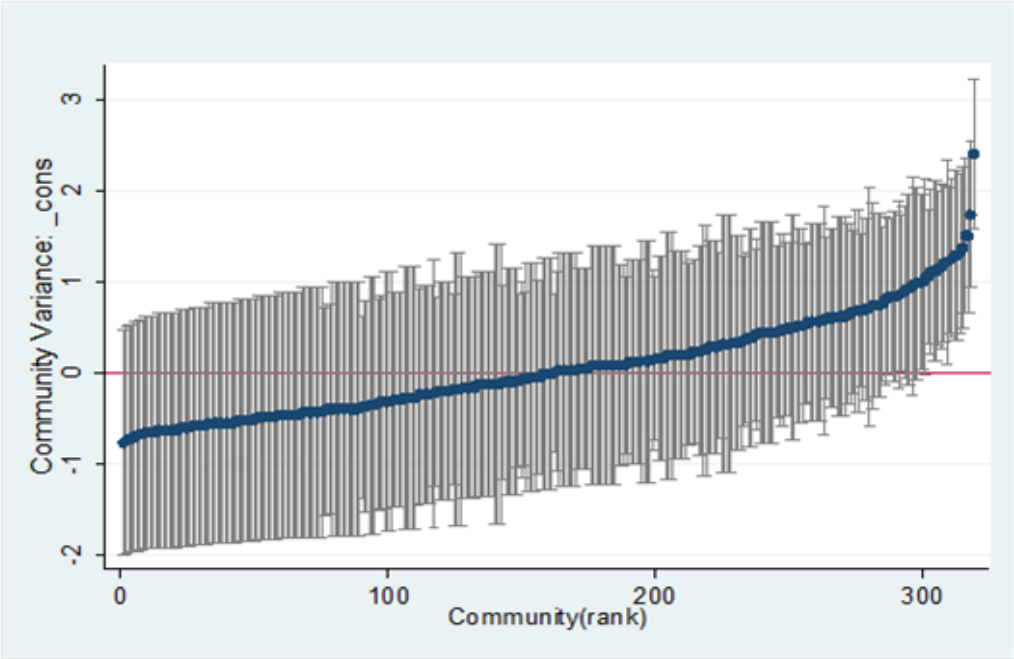
Figure 6.3 shows the percentage distribution of inter-class correlation and PCV in relation to exposure to risk due to short birth interval. The ICC for Model 1 (Null Model) was17 percent, Model 2 (individual variables) was 14 percent, Model 3 (neighbourhood) was 13 percent, Model 4 (both interval and neighbourhood) was 12 percent and the final model with cross-level variable was 13 percent.

**Figure 6.3: Percentage distribution of ICC and PCV**




Looking at the confidence intervals displayed in Figure 6.4, the confidence intervals for their residuals of about 16 neighbourhoods at the top end of the plot do not overlap zero. Remembering that these residuals represent neighbourhood departures from the overall average line predicted by the fixed parameters, this means that the majority of the neighbourhoods do not differ significantly from the average line at the 5 percent level. However, these neighbourhoods whose residual shows the highest positive deviations have the largest effect on risk of short birth interval. About two outliners were observed.

**Figure 6.4 Neighbourhood variance (residual), standard error and ranking with 95 percent confidence interval for risk of short birth interval**




### 6.3: Independent effects of individual and neighbourhood factors on risky maternal age

The effects of individual aspects on age risk are presented in this sub-section. In Table 7.3.1 below, the total variance in exposure to risk of maternal age associated with neighbourhoods was estimated using the null model (Model 1). The model contains no variables but partitions the total variance into the sum of the individual- and neighbourhood components and in addition provides an estimate of intra-class correlation coefficient (ICC) or variance partition coefficient (VPC).

Results in the null model showed that there is differential in the likelihood of being in the risk age group at the time of delivery across neighbourhoods. This differential was significant ($\tau = .0292894$, $p < 0.000$). As indicated by the variance partition coefficient, the intra-class correlation (ICC) observed in the null model indicates that 1.5 percent of the residual differential in the propensity to exposure of risk age is attributed to factors operating at neighbourhood level. Model 2 contained only the individual-level variables. Results showed that marital status was significantly associated with exposure to risk age.

The risks of maternal age of married women were attenuated but are still significantly lower than women that never married (AOR=0.745 95 percent CI: 0.57-0.98), whilst the formerly married had increased odds. There was no statistically significant association between women's views on proximity to health facility and exposure to risk age. Women with secondary/higher education had lower odds of exposure to risk age than women with no education; increasing wealth status was associated with increased odds of exposure to risk age. Compared to the null model, the differential in exposure to risk age was significant across neighbourhoods ($\tau$ = .031972, $p<0.001$). The intra-neighbourhood correlation was only 2 percent of the variability in exposure to high risk pregnancy.

Model 3 introduced neighbourhood variables (neighbourhood women's education level, neighbourhood employment level, neighbourhood rural/urban residence, neighbourhood HIV risk assessment, neighbourhood facility delivery, neighbourhood maternal education awareness and region of residence). The risk of maternal age was significantly associated with neighbourhood place of delivery and place of residence. Skilled birth attendant at the facility had reduced odds compared to home birth (AOR= 0.643, 95 percent CI: 0.54-0.76). The odds of exposure to age risk by rural neighbourhoods were 1.25 times higher than urban neighbourhoods (CI: 1.05-1.48).

There was no statistical significance association between region, awareness of maternal education, employment levels and the outcome variable. The differential in risk of maternal age in Model 3 remained significant across neighbourhoods ($\tau$ = .0254138, $p<0.001$). The variance partition coefficient revealed that an intra-neighbourhood correlation was 1 percent.

The proportional change in variance in the odds of risks of maternal age across neighbourhoods (20.5 percent) was explained by the neighbourhood aspects, indicating that part of the clustering of risk of maternal age within areas is due to the composition of the neighbourhood aspects. In addition, the inclusion of the neighbourhood factors reduced the neighbourhood variance from .031972 to .0254138 ($p<0.001$).

With the inclusion of both individual and neighbourhood factors in Model 4, the likelihood of exposure to risk age was increased for women residing in rural neighbourhoods (AOR= 1.25 95 percent CI: 1.01-1.51) compared to women from urban neighbourhoods. For every added level of education, the odds exposure to risk age was reduced. The risks of maternal age for women with higher education were attenuated but are still significantly lower than women with no education. Women with primary education had 31 percent reduced odds and women with secondary and higher had 57 percent reduced odds of exposure to risk age. Married women had lower odds of exposure to risk age (AOR=0.747 95 percent CI: 0.58-0.92) whilst the formerly married had increased odds (AOR= 1.418 95 percent CI: 1.07-1.81). Neighbourhood health facility delivery had reduced odds compared to delivery at home (AOR= 0.623, 95 percent CI: 0.52-0.74). The differential in risk of maternal age in Model 4 remained significant across neighbourhoods ($\tau$ = .027681, $p<0.001$). The variance partition coefficient indicated that an intra-neighbourhood correlation was still 1 percent.

The proportional change in variance in the odds of risks of maternal age across neighbourhoods (-8.9 percent) was explained by the neighbourhood- and individual-level aspects, indicating that part of the clustering of risk of maternal age within areas is due to the composition of both individual- and neighbourhood aspects. In addition, the inclusion of the neighbourhood factors increased the neighbourhood variance from .0254138 to .027681 ($p<0.001$).

Finally, Model 5 included a cross-level interaction of education with marital status. Marital status, educational level, wealth status and neighbourhood place of delivery maintained a statistical significance, even after adding the cross-level variable. Surprisingly, HIV risk assessment was now statistically significant as it had not been significant in the whole analysis. High- and medium-neighbourhood HIV risk assessment was increasingly associated with risk age (AOR=1.40 95 percent CI: 1.11-1.77) and medium risk (AOR=1.23 95 percent CI: 1.01-1.5) compared to neighbourhoods with low HIV risk assessment. The behaviour of education across marital status in the neighbourhoods proved to show the statistical

significance. Regardless of the marital status, education across marriages in the neighbourhoods was statistically significant with women with no education regardless of their marital status having higher odds of risk age compared to women with primary and secondary education.

The differential in risk of maternal age in Model 4 remained significant across neighbourhoods ($\tau$ = .0305103, $p<0.001$). The variance-partition coefficient indicated that an intra-neighbourhood correlation was still 1 percent. The proportional change in variance in the odds of risks of maternal age across neighbourhoods (-3.4 percent) was explained by the neighbourhood- and individual-level aspects, indicating that part of the clustering of risk of maternal age within areas is due to the composition of both individual- and neighbourhood aspects. In addition, the inclusion of the neighbourhood factors increased the neighbourhood variance from 0.0294207 to .0305103 ($p<0.001$).

Assessing the median of these odds ratios between the women living in the neighbourhood with the higher propensity of exposure to risky maternal age and women living in the neighbourhood with the lower propensity is estimated to be 1.19 in Model 1. This is a low odds ratio, implying that the clustering effect is small even without inclusion of any cluster-level covariates. When individual variables are included (Model 2), the unexplained cluster heterogeneity (comparing persons from neighbourhoods of the same kind) increased, yielding an MOR of 1.23, which is still a very low odds ratio. When neighbourhood factors (Model 3), individual and neighbourhood (Module 4) and all factors including cross level are included; the MOR decreases further, indicating very little differential between neighbourhoods in the propensity for exposure to risky maternal age. These results confirm what has been revealed by ICC values.

**Table 6.3: Multilevel logistic regression odds ratio of the effects of individual and neighbourhood factors on risky maternal age at birth, ZDHS 2007**

| Variable<br><br>Fixed effects | Model 1 (Empty) | Model 2 Individual<br><br>Odds Ratio | Model 3 Community<br><br>Odds Ratio | Model 4 Individual and community<br><br>Odds Ratio | Model 5 Individual and community with cross level interaction<br><br>Odds Ratio |
|---|---|---|---|---|---|
| Individual characteristics | | | | | |
| **Marital Status** | | | - | | |
| Never Married | | 1.000 | - | 1.000 | 1.000 |
| Currently Married | | .745** | - | .747* | 2.533* |
| Formerly Married | | 1.429*** | - | 1.418** | 5.93* |
| **Highest Level of Education** | | | - | | |
| No Education | | 1.000 | - | 1.000 | 1.000 |
| Primary | | .725*** | - | .709*** | 3.198** |
| Secondary/Higher | | .462*** | - | .434*** | 1.401* |
| **Wealth Status** | | | - | | |
| Poor | | 1.000 | - | 1.000 | 1.000 |
| Average | | .984 | - | .998 | 1.00 |
| Rich | | 1.337** | - | 1.257* | 1.285* |
| **Place of Residence** | | | - | | |
| Rural | | 1.000 | - | 1.000 | 1.000 |
| Urban | | .887 | - | .968 | .901 |
| **Distance to Health Facility** | | | - | | |
| No Problem | | 1.000 | - | 1.000 | 1.000 |
| Problem | | 1.089 | - | 1.076 | 1.064 |
| **Community Characteristics** | | - | | | |
| **Community Education** | | - | | | |
| Low | | - | 1.000 | 1.000 | 1.000 |
| Medium | | - | 1.096 | 1.199* | - |
| High | | - | 1.164 | 1.412* | |
| **Employment Level** | | - | | | |
| Low | | - | 1.000 | 1.000 | 1.000 |
| Medium | | - | 1.109 | 1.116 | 1.116 |
| High | | - | 1.109 | 1.117 | 1.154 |
| **Place of Residence** | | - | | | |
| Urban | | - | 1.000 | 1.000 | 1.000 |
| Rural | | - | 1.266*** | 1.250** | |
| **Place of delivery** | | - | | | |
| Home | | - | 1.000 | 1.000 | 1.000 |
| Health facility | | - | .650*** | .623*** | .641*** |
| **HIV risk Assessment** | | - | | | |
| Low | | - | 1.000 | 1.000 | 1.000 |
| Medium | | - | 1.04 | 1.014 | 1.193* |
| High | | - | 1.055 | 1.001 | 1.297* |
| **Awareness Maternal Educ.** | | - | | | |
| Low | | - | 1.000 | 1.000 | 1.000 |
| Medium | | - | .918 | .924 | .956 |
| High | | - | .914 | .926 | 1.039 |

| | | | |
|---|---|---|---|
| **Region** | | | |
| Central | 1.000 | 1.000 | 1.000 |
| Copper-belt | 1.158 | 1.134 | 1.076 |
| Eastern | 1.159 | 1.124 | 1.054 |
| Luapula | .859 | .881 | .885 |
| Lusaka | 1.130 | 1.074 | 1.058 |
| Northern | .947 | .924 | .943 |
| North-Western | .925 | .903 | .937 |
| Southern | 1.058 | 1.028 | 1.024 |
| Western | .933 | .888 | .949 |
| **Educ. x marital status** | | | |
| None x Never married | | | 1.000 |
| Primary x currently married | | | .229*** |
| Sec/higher x currently married | | | .322** |
| Primary x formerly married | | | .171*** |
| Sec/higher x formerly married | | | .268** |

| **Random effects Parameters** | **Empty** | **Individual** | **Community** | **Individual & community** | **Individual & community cross level interaction** |
|---|---|---|---|---|---|
| Variance (SE) | .0292894 | .031972 | .0254138 | .027681 | .0286265 |
| VPC=ICC (%) | 1.5 | 1.9 | 1 | 1 | 1.1 |
| PCV (%) | Ref | -9.2 | 20.5 | -8.9 | -3.4 |
| ***Log-Likelihood*** | -2922.271 | -2868.679 | -2905.187 | -2850.526 | -2853.1888 |
| ***Model fit statistics*** | | | | | |
| AIC | 5848.542 | 5757.359 | 5838.375 | 5745.051 | 5740.378 |
| BIC | 5861.324 | 5821.268 | 5927.848 | 5885.652 | 5849.024 |
| LR test | | | | | 2.15* |
| Lr test | - | - | -73.02 | 36.31*** | 30.98*** |
| Lr test null model nested | | 107.18*** | 34.17*** | 143.49*** | 144.65*** |

The null model contains no variables but partitions the variance into two components, SE = Standard error, VPC= Variance Partition Coefficient, PCV = Proportional Change in Variance, AIC=Akaike information criterion, BIC = Bayesian information criterion Significance level *p<0.05

Figure 6.5 shows the percentage distribution of ICC and PCV in relation to risk of maternal age. ICC ranged from 1.5 percent (Null Model) to 1.9 percent (individual aspects), 1 percent (neighbourhood aspects), 1 percent (both individual and neighbourhood) and 1.1 percent (full model with cross-level variable).

**Figure 6.5: Percentage distribution of ICC and PCV**

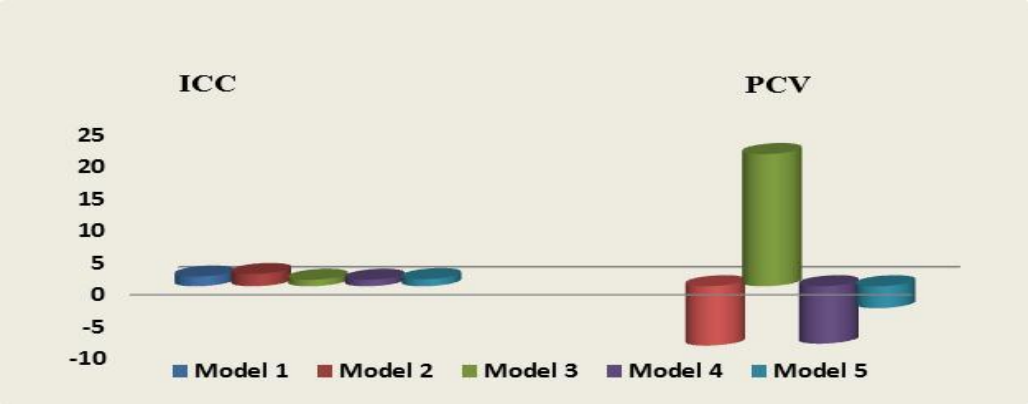
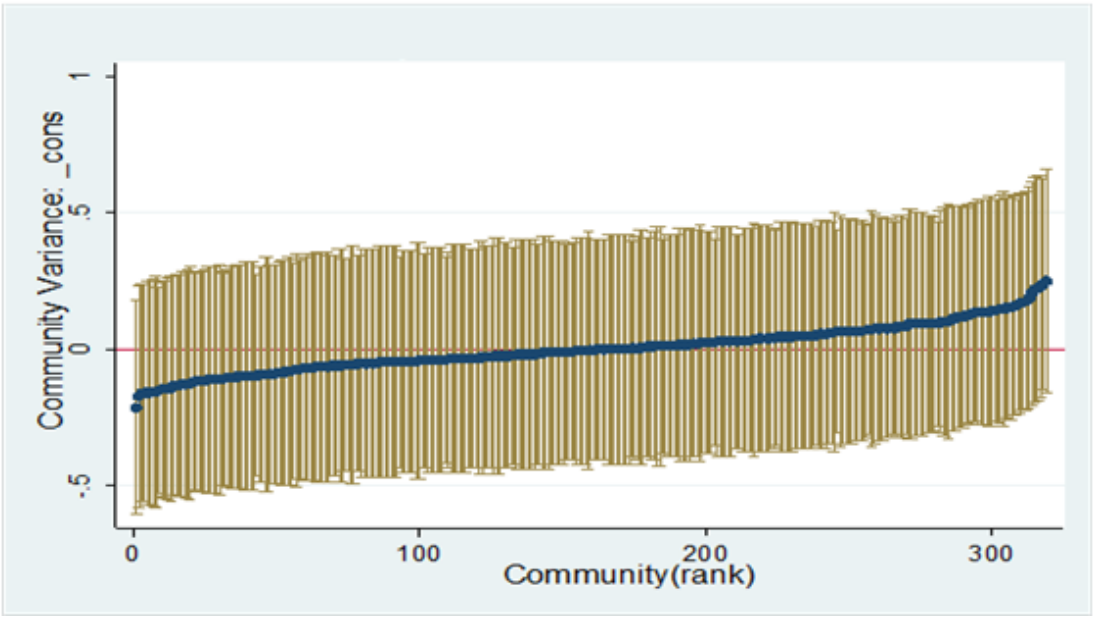



Figure 6.6 shows the estimated residuals for all 319 neighbourhoods in the sample. For all the neighbourhoods their confidence interval overlapped the horizontal line at zero, indicating average exposure to age risk in these neighbourhoods is not significantly different from the grand mean.

**Figure 6.6 Neighbourhood variance (residual), standard error and ranking with 95 percent confidence interval for risk maternal age**



## Chapter Seven – Study Hypothesis and Discussion

### 7.0 Introduction

This section provides a hypothetical background for the theories tested. The ecological theory has established a link between residential environment and an individual's health outcome (Ellen et al. 2001). This theory also provides a detailed explanation for the hypotheses tested. Literature has confirmed that residence in a deprived neighbourhood tends to influence health outcomes (Aremu et al. 2011).

### 7.1: Study hypothesis

The following five research hypotheses were tested and focused on the relationship between several independent variables and exposure to high risk pregnancy:

### 7.2: Hypothesis 1

$H_{1:}$ Region of residence is a significant predictor of exposure to maternal mortality risks. This is on the premise that environmental conditions such as low socioeconomic development and low socioeconomic status and the location of more healthcare services in the urban areas than in the rural areas exposes rural women to high risk pregnancy due to non-utilisation of maternal health services (Ronsmans & Graham, 2006c).

Context findings: A significant association between region of residence and exposure to high risk pregnancy ($p<0.05$) was revealed. Findings indicated region of residence as a significant predictor of the outcome variables, ($p<0.05$), thereby leading to rejection of the null hypothesis (H0). As specified in the alternative hypothesis (H1), evidence confirmed that exposure to high risk pregnancy is lower among women from urban provinces of Zambia than rural provinces. This suggests that residence in a particular province in Zambia is significantly associated with regional differentials in exposure to high risk pregnancy across the country. For instance, residing in Lusaka, the urban province of Zambia, is associated with the lowest risks of exposure to high risk pregnancy compared to residing in Northern, a rural province.

### 7.3: Hypothesis 2

$H_{1:}$ Neighbourhoods with high proportions of deliveries attended by skilled health personnel are associated with lower maternal mortality risks. This is based on the assumption that women who never utilised skilled birth attendance were exposed to higher risks of adverse birth outcomes and that a high proportion of skilled delivery is a proxy for use of facility health services and interaction with skilled personnel; which in turn has the potential to decrease exposure to high risk pregnancy (Antai, 2009; Phiri et al., 2014; Stephenson et al., 2007).

Context finding: The findings of bivariate and multivariate analyses showed that skilled birth attendance at delivery significantly lowered the risks of exposure to adverse pregnancy outcome. The likelihood of having institutional delivery was higher for women who lived in neighbourhoods with a high proportion of women who delivered at a health facility compared to women who lived in neighbourhoods that gave birth at home. This result confirms the second hypothesis of the study**.**

### 7.4: Hypothesis 3

$H_{1:}$ A lower risk of exposure to high risk pregnancy is associated with residences and neighbourhoods that have a high rate of women with post-primary education.

Context finding: Literature has established that women with high education are better informed on health matters, thus they make informed decisions concerning their health, and are better placed to overcome cultural barriers to maternal healthcare use (Greenaway et al. 2012). Literature furthermore has shown that secondary or higher education contexts tend to provide social capital that increases the survival chances of women who themselves have little or no education but reside in neighbourhoods that had a high proportion of people post primary education. Furthermore, lack of education is highlighted as one of a number of stressors affecting women during pregnancy and childbirth, increasing the likelihood of exposure to pregnancy risk as has been observed (Karlsen et al. 2011), hence; it was hypothesised that neighbourhoods

with a high proportion of women having secondary or higher education is significantly associated with reduced risk of exposure to adverse birth outcomes. The result therefore confirms this hypothesis.

### 7.5: Hypothesis 4

$H_{1:}$ Neighbourhood factors are more significant predictors of exposure to high risk pregnancy than individual factors in Zambia. Hypothesis 4 posits that neighbourhood variables are more significant predictors of exposure to adverse pregnancy outcome than individual and household variables in Zambia. This is based on the assumption that the differences of some individual effects on exposure to adverse pregnancy outcome are due to functions of neighbourhood or neighbourhood effects (Ononokpono et al., 2014).

Context finding: Results of the multilevel analysis in Chapter 7 showed that neighbourhood variables moderated the effects of the association between individual variables and exposure to adverse pregnancy outcome. The inclusion of the neighbourhood variables in Model 4 (Tables 7.1, 7.2 and 7.3) resulted in the reduction of odds in exposure to adverse pregnancy outcome across the categories of individual-level variables compared to results when neighbourhood variables were included. The result therefore confirms the fourth hypothesis.

### 7.6: Hypothesis 5

$H_{1:}$ Women with low autonomy levels are associated with elevated risk of exposure to high risk pregnancy.

This is of the premise that higher female autonomy creates an egalitarian neighbourhood where women are able to make the correct decisions about their health during pregnancy and are able to negotiate better quality maternal healthcare services (Bloom et al., 2001; Corroon et al., 2014; Gabrysch & Campbell, 2009; Ononokpono & Azfredrick, 2014; Sado et al., 2014; Woldemicael, 2007).

Context finding: Although results indicated that women with low autonomy had increased odds of exposure to high risk pregnancy compared to the women with high autonomy, the results were not

significant ($p<0.09$). Further analysis of autonomy level with use of health facility at birth and utilisation of health facilities confirmed the significance of low autonomy having an effect on choosing home delivery and failing to use health facilities due to distance. The result therefore does not confirm the significance of the fifth hypothesis on exposure to high risk pregnancy.

### 7.7: Discussion

The aims of this chapter were to assess the influence of individual and neighbourhood aspects on exposure to high risk pregnancy. This study shows that variables associated with exposure to high risk pregnancy in Zambia operate at different levels. The results demonstrate the impact of individual, household, and neighbourhood influences on exposure to high risk pregnancy. Exposure to high risk pregnancy was first analysed in relation to exposure to high risk pregnancy. Formerly and currently married women were significantly associated with exposure to high risk pregnancy, echoing studies in Ghana (Asamoah et al. 2011) although this is less consistent with the study findings in Tanzania by Evance and colleagues who found that single women were more exposed to risk than married women (Evance 2013). A possible explanation for these results is that some married women have to seek permission from their spouses or other relatives to go to the health facility, unlike single mothers. Studies in sub-Saharan Africa show that many married women have constrained independence in the reproductive and sexual realms (DeRose & Ezeh 2005; Derose et al. 2010). The above findings are also indicative of the findings by Imasiku et al., (2015) on high rates of unmet need by married women in Zambia. Unmet need is one of the possibilities of exposure to the risk of having children over a short birth interval or an increase in number of children. Since short birth interval and children ever born are components of the outcome variable (high risk pregnancy), it explains why ever married women in this study were found to be more exposed to high risk pregnancy compared to the never married.

Additionally, higher parity women may be exposed to many challenges related to cost and time which prevent them from utilising health facilities. In this study, women with no education were found to be more exposed to high risk pregnancy than women post primary education. Several studies have systematically recognized an inverse relationship between education and exposure to maternal health risks (Pillai et al. 2013; Magadi et al. 2001; Koch et al. 2012; Tunçalp et al. 2014). This relationship makes intuitive sense since education has an influence on various factors that affect health matters. It is reasonable to argue that women with high education have been found to be better informed on health matters, thus they make informed decisions concerning their health, and are better placed to overcome cultural barriers to maternal healthcare use (Greenaway et al. 2012).

Additionally, lack of education is highlighted as one of a number of stressors affecting women during pregnancy and childbirth, increasing the likelihood of exposure to pregnancy risk as has been observed (Karlsen et al. 2011). This finding is important because it emphasises the role of education for the mother in obtaining and understanding the benefits of good health and being able to make appropriate decisions during pregnancy (Yego et al. 2014). Karlsen hypothesises that many of the health disadvantages associated with low levels of maternal education can be addressed through universal access to quality health services; however, this hypothesis has not been tested empirically (Karlsen et al. 2011).

Poor household wealth equates education in that it is a structural factor that affects a woman's ability to seek healthcare through different channels, including availability of services, financial accessibility, geographic accessibility, knowledge and attitudes towards services (Peters et al., 2008). Consistent with prior research in Zambia (MacKeith et al. 2003) and elsewhere (Ahmed et al., 2010; Fotso, Ezeh, & Essendi, 2009), this study found a positive relationship between poor wealth status and exposure to high risk pregnancy. Women from a richer household status may be able to seek care during pregnancy, with the costs of seeking care acting as a significant barrier to women from a poor wealth status. Consistent with previous studies, women in rural places have been cited to be exposed to risks of pregnancy-related deaths

(Ononokpono & Odimegwu, 2014; Yaya & Lindtjørn, 2012; Ronsmans & Graham, 2006). In Zambia, this has been attributed to lack of basic EMOC in some rural health centres (Owens et al., 2015; Saving Mothers Giving Life Report, 2013). This study suggests minimum significant neighbourhood compositional effects on exposure to high risk pregnancy although the findings are not consistent with the outcome variable. Two other neighbourhood compositional factors are significantly associated with exposure to high risk pregnancy: neighbourhood place of residence and neighbourhood place of delivery.

The negative relationship between exposure to high risk pregnancy and delivery at health facilities constitutes a problem that is consistent with the facility use phenomenon (i.e. increased exposure to high risk pregnancy for every delivery at home) that several studies have highlighted in Zambia (Chama & Koch, 2013; Stekelenburg et al., 2004) and elsewhere (Montagu et al. 2011). There was minimum significant clustering of exposure at high risk pregnancy at the neighbourhood level, even after controlling for variables at individual and neighbourhood level.. In other words, there are unobserved neighbourhood factors that affect exposure to high risk pregnancy.

The significant effect of the percentage of women in the neighbourhood with secondary education and higher reveals how the neighbourhood influences the behaviour pattern of women concerning their health. In less developed societies such as Zambia, levels of female education are often low and the attainment of secondary education or higher often reflects higher socioeconomic status. Neighbourhoods in which a higher percentage of women achieve post-primary education are therefore likely to be neighbourhoods with higher percentages of socioeconomically advantaged households. Greater household wealth may enable women to seek care during pregnancy, with the costs of seeking care acting as a significant barrier to women from poorer households.

On the other hand, women of low education and economic status have been associated with non-usage of maternal health services, which exposes them to adverse birth outcomes as health professionals cannot provide prompt treatment for any health problems during pregnancy (Titaley et al. 2010). Higher levels of

female education in the neighbourhood may also point to greater awareness of the need for care during childbirth. Although the content of formal education may not include health information, higher levels of education may create a greater awareness of health services and the need for care. Take for instance Malaysia's 65 percent reduction in maternal mortality because of an emphasis on education for women, in the realisation that investment in young people is an investment in the future of the country (Karim & Ali 2013). The significance of education at individual and neighbourhood level suggests that the influences on individual health behaviour extend to practices of others in the neighbourhood.

The percentage of women in the neighbourhood who had delivered a child in a health facility had a strong positive influence on reduction of exposure to high risk pregnancy. There are several possible pathways of influence. Previous studies have shown that women's decisions regarding the seeking of healthcare are strongly influenced by the practices of others in the neighbourhood; in a neighbourhood in which a high percentage of women use health services for childbirth, the practice is therefore likely to be an influential individual behavioural norm.

One innovation in this study was assessment of the relationship between cross-level variables (measured as the interaction of education with marital status) and exposure to high risk pregnancy. Marital status, educational level, wealth status, neighbourhood place of delivery, individual and neighbourhood place of residence maintained a statistical significance, even after adding the cross-level variable. Education proved to show a statistical significance over marital status. Regardless of marital status, behaviour of education across marriage in the neighbourhoods was statistically significant, with women with no education regardless of their marital status having higher odds of exposure to high risk pregnancy compared to women with primary and secondary education.

Exposure to risk due to short birth interval was analysed. Results indicate that there is differential in the likelihood of having three or more children in less than five years at the time of delivery (short birth interval) across neighbourhoods. As indicated by the variance partition coefficient, the intra-neighbourhood

correlation coefficient as shown by the estimated intercept component variance was estimated at 17 percent, which is variability in the outcome variable that could be attributed to the neighbourhood level. The intra-class correlation (ICC) observed in the null model indicates that 17 percent of the residual differential in the propensity to exposure risk of short birth interval is attributed to factors operating at neighbourhood level. Wealth status was significantly associated with risk of short birth interval. There was no statistical significant association between marital status, women's education level and exposure risk of short birth interval. Increasing wealth status and residing in urban area was associated with reduced odds of exposure risk of short birth interval. One of the reasons for having children in a short interval is non-use of maternal health services. At neighbourhood level, rural residence was found to be positively associated with increased odds of exposure risk of short birth interval.

Our findings are in tandem with other studies in which maternal mortality was found to be high in rural areas compared with urban areas (Ronsmans et al., 2003; Sialubanje et al., 2014). Women residing in Western Province had reduced odds in having three or more children under five at time of delivery compared to women from Central Province. In the final model, which included a cross-level interaction of education with marital status, wealth status and place of residence maintained a statistical significance, even after adding the cross-level variable. The interaction between education and marital status in exposure risk of short birth interval had no effect since the formerly married women post primary education had higher odds of exposure risk of short birth interval compared to women with no education and who never married. This could be attributed to the fact that delayed education might push women to have children in a short period of time because of time spent studying and not having families. Surprisingly, neighbourhood HIV risk assessment was statistically significant as it has not been significant in all the models. High neighbourhood HIV risk assessment was increasingly associated with exposure risk of short birth interval compared to neighbourhoods with low HIV risk assessment. This is not surprising as women exposed to

HIV are associated with substantial increases in the risk of death, both during pregnancy and postpartum and maternal mortality audits (McIntyre, 2003).

As signified by the VPC and PCV, the results persistently demonstrate that individual causes were significantly higher in revealing exposure to risk maternal age, while neighbourhood aspects were significantly higher in revealing exposure to having three or more children under five at time of birth.

Although neighbourhood aspects seem to impact the relationship between individual circumstances and the three outcome variables (HRP, short birth interval and risky maternal age), the outcome shows that the neighbourhood impact were advanced for risks of having three or more children under five compared with exposure to high risk pregnancy. Moreover, after adjusting for the influence of personal and neighbourhood variables, the findings established higher exposure to having three or more children under five concentrations at the neighbourhood level proportionate to the individual level. Contrary, extreme exposure to high risk pregnancy concentrations was revealed at a personal level compared with the neighbourhood level. These results establish that neighbourhood characteristics seem to play a more significant part in birth interval than high risk pregnancy. This study is not able to predict the reasons for such; however, high risk pregnancy has three compositions, whilst birth interval, being a single factor, is easy to predict.

### 7.8: Conclusion

The relationship between individual and neighbourhood circumstances and the exposure to high risk pregnancy was examined in this chapter. The multilevel analysis has shown that neighbourhood aspects contribute more significantly to birth interval than high risk pregnancy. This study is not able to predict the reasons for such; however, high risk pregnancy has three compositions, whilst birth interval, being a single factor, is easy to predict.

The multilevel framework demonstrated significant neighbourhood differentials in the exposure to high risk pregnancy. Reduction in exposure to high risk pregnancy depends on the effective use of skilled

delivery at birth and access to adequate EmOC. Use of skilled delivery at birth is correlated with uptake of antenatal care services. A study on impact of neighbourhood aspects on the utilisation of focused antenatal care conducted in Zambia reported strong neighbourhood influences in explaining individual-level differentials on insufficient antenatal visits in rural areas. This study further established that the extent to which differences in the neighbourhoods explain individual differentials in inadequate use of antenatal services was explained by individual-level aspects, as evidenced by low ICC of 6 percent to 11 percent. The outcomes of this research reveal the need to look beyond individual aspects when investigating exposure to high risk pregnancy.

The results of our study revealed a very strong and positive influence of lower household socioeconomic status on all three indicators of exposure to high risk pregnancy. Previous studies have also noted a positive relationship between socioeconomic position and maternal mortality risks (Babalola, 2014; Cárdenas-Cárdenas et al., 2015; Ononokpono & Odimegwu, 2014). Findings regarding the effect of higher education levels on women's exposure to high risk pregnancy are persistent with past studies in Zambia and other nations; the more learned women are better aware of their health, know more about the provision of maternal healthcare facilities and use this awareness and information in accessing healthcare utilities (Chama-Chiliba & Koch, 2013; Scott et al., 2013; Titaley et al., 2010; Tunçalp et al., 2014). Access to and provision of healthcare utilities are normally of higher quality in the urban areas. The finding of our study regarding stronger effects of rural dwelling on exposure to high risk pregnancy is consistent with previous studies in Zambia (Michelo 2010).

The findings of our study propose that the use of skilled attendance at delivery had a significant effect on exposure to high risk pregnancy and the three outcome variables (high risk pregnancy, short birth interval and risky maternal age). The findings have implications for evidence-based programming for risks of adverse pregnancy outcome. These findings highlight the need to adopt multilevel approaches along with addressing the factors which affect exposure to high risk pregnancy at individual and neighbourhood level.

The amount of differential at neighbourhood and individual level found in our study indicates the need to contextualise efforts for increasing resources in mitigating risks of high risk pregnancy. Our study also revealed the presence of unmeasured factors at neighbourhood and individual level, influencing exposure to adverse birth outcomes. Hence, adopting neighbourhood-specific strategies along with identifying and addressing neighbourhood factors affecting exposure to high risk pregnancy, would give better results.

Furthermore, many of the aspects at personal and neighbourhood level considered in this research were strongly related to high risk pregnancy in comparison to short birth interval and risk maternal age. For example, dwelling place appears to affect exposure to high risk pregnancy more than risky maternal age. The results of this study suggest that residence in a particular province of Zambia is a major determinant of exposure to adverse pregnancy outcome in the country. These findings may be attributed to spatial inequality in social and economic development between provinces (Antai et al., 2010), benefits of greater service availability afforded to urban residents (Stephenson, et al., 2006), variations in maternal literacy amongst and across regions, variations in neighbourhood literacy and use of preventive healthcare utilities (Koch et al. 2012). Furthermore, other causal mechanisms like area differentials in health provision could be liable for the wide discrepancies in age risk and short birth outcome between the urban and rural provinces of Zambia.

Other than dwelling place, other neighbourhood aspects found to exert a massive impact on age risk and risk due to short birth interval in Zambia include place of residence, neighbourhood facility delivery and neighbourhood poverty level. Taking place of residence for example, exposure to the three outcome variables is expected to be advanced in the areas that are remotely rural compared with the more urbanised provinces.

## Chapter Eight – Conclusion and Recommendations

### 8.1: Conclusion

This study examined maternal mortality risks in Zambia and presented a new method that can help policy planners in identifying high risk areas and prioritise target settings and help in accelerating the attainment of sustainable development goals. The model used in this study can be used to estimate maternal mortality ratio, given information on maternal health of the women. This new method is much easier to use at any level and quicker to forecast interventions as well prevent probable risks. In addition, the proposed model is better suited to the practical needs of mortality estimation, since both input parameters are continuous. The model proposed here could serve as the basis for a new and better system of maternal mortality estimation for nations with incomplete vital registration data. Although the method may not always provide a precise estimate for each province, it does provide an overview of the distribution of maternal mortality risks throughout Zambia.

The findings suggest that there are a number of issues to address in order to reduce maternal mortality in Zambia. Women's high-risk reproductive behaviours and the use of essential maternal healthcare utilities have yet to improve significantly to result in a reduction in maternal mortality in the country. The prevalent inequalities in maternal mortality hardship by province, urban- rural residence and socioeconomic status of the population, worsen the problem; making attempts to enhance maternal health and thereby reduce maternal mortality, more challenging. Strategies to reduce high risk pregnancies should either lower the chances that a woman will become pregnant or reduce the probability that a pregnant woman will experience a serious complication of pregnancy or childbirth or improve the outcomes for women with adverse reactions (McCarthy & Maine 1992). This study highlights that strategies to address maternal mortality in the country require diverse approaches that encompasses several preventive and treatment interventions such as preventing high risk pregnancy and improving women's access to quality maternal healthcare services.

The use of multilevel analysis in this research has revealed that personal and neighbourhood aspects are significant components associated with the exposure to high risk pregnancy. The multilevel framework demonstrated significant neighbourhood differentials in the exposure to high risk pregnancy. Reduction in exposure to high risk pregnancy depends on the effective use of skilled delivery at birth and access to adequate EmOC. The results of our study showed a very strong positive influence of lower household socioeconomic status on all three indicators of exposure to high risk pregnancy. Findings regarding effect of higher education levels and women's exposure to high risk pregnancy are consistent with other studies that have shown that; the higher the woman's education, they are better aware about their health, know more about provision of maternal healthcare services and use this awareness and information in accessing healthcare services.

The findings of our study suggest that exposure to high risk pregnancy had a noteworthy effect on the use of skilled attendance at delivery and the three outcome variables (high risk pregnancy, short birth interval and risk maternal age). The findings of our study have implications for evidence-based programming for risks of adverse pregnancy outcome. These findings highlight the need to embrace multilevel approaches onward, in dealing with factors affecting exposure to high risk pregnancy at individual and neighbourhood levels. The amount of differential at neighbourhood and individual level found in our study indicates the need to contextualise efforts for increasing resources in mitigating risks of high risk pregnancy. Our study also revealed the existence of unmeasured factors at neighbourhood and individual level, influencing exposure to adverse birth outcomes. Hence, adopting neighbourhood-specific strategies along with identifying and addressing neighbourhood factors affecting the exposure to high risk pregnancy, would give better results. Furthermore, many of the aspects at personal and neighbourhood level considered in this research were strongly related to high risk pregnancy in comparison to short birth interval and risk maternal age. For example, dwelling place seems to influence exposure to high risk pregnancy more than maternal age risk. The result of this study suggests that residence in a particular province of Zambia is a

major determinant of exposure to adverse pregnancy outcome in the country. Other than dwelling place, it was revealed that other neighbourhood aspects have a great effect on age risk and risk due to short birth interval in Zambia, including place of residence, neighbourhood facility delivery and neighbourhood poverty level. In the case of dwelling place for example, exposure to the three outcome variables is expected to be advanced in the provinces that are remotely rural compared with the more urbanised provinces. The findings of this research have revealed that neighbourhood aspects are significant predictors of exposure to high risk pregnancy. Moreover, they mitigated the relationship between personal factors and exposure to high risk pregnancy.

### 8.2: Relevancy to demography

This study is relevant to demography because it has tackled issues related to population dynamics like health and mortality, areas of interest for demographers. In dealing with health issues related to maternal mortality risks, this study becomes vital to demographers as it has proposed the use of a model that is vital to use in countries that do not have vital registration systems. Demography is a multidisciplinary subject which emphasises rigorous data analysis using specific methods accompanied by theory, and is often associated with statistics. In this study, health inequality factors among neighbourhoods were ably analysed in relation to exposure to maternal mortality risks using a multilevel model. Every government relies on data from demographers in seeking ways to tackle persistent health inequalities. This study has bridged that gap by identifying the major risk factors of maternal mortality in Zambia, proposed ways of enhancing healthcare systems and made recommendations on what the Zambian government can do using the full range of policy instruments in trying to reduce or prevent the risks of maternal mortality.

### 8.3 Suggestions for further research

Addressing the whole issue of maternal mortality and pregnancy-related adverse reactions is beyond the scope of this thesis. However, efforts have been made to identify some important issues that are

particularly relevant to Zambia. The multilevel analysis of factors affecting exposure to high risk pregnancy conducted as part of this thesis revealed a significant amount of differential in terms of neighbourhood and individual aspects regarding exposure to high risk pregnancy.

Further research should be conducted to investigate the factors that may account for the unexplained neighbourhood and individual differentials in exposure to high risk pregnancy. More emphasis should be placed on research of social, environmental and economic interventions since there are huge knowledge gaps. There is a need to improve on the relationship between research and policy so as to make it interactive. Furthermore, there is a need to strengthen plans for testing policies which target maternal risk factors against available evidence so that it becomes a continuous process whereby policy is modified, refined and reshaped according to the evidence as it becomes available.

### 8.4: Implications of the findings for policy makers

High risk pregnancy was prevalent across all regions of the country, especially in the rural regions There is a need to implement strategies at different levels (neighbourhood, health facility and policy levels), targeting prevention of high risk pregnancy. Prevention of high risk pregnancy through effective maternal health programmes where males are involved as dependable partners in addressing high risk pregnancy, should be instituted. Awareness programmes need to target the neighbourhood and recognise its role in preventing maternal mortality risks.

This study documents a lack of utilisation of health facilities for delivery among women with high risk pregnancy. This may worsen the maternal mortality risk of women with high risk pregnancy. Reproductive health programmes need to identify such pregnancies in the neighbourhoods and encourage women to deliver at health facilities and attend antenatal care services. Health workers need to initiate proactive counselling for such women and ensure that such women receive adequate care and all the necessary information, counselling and care services during their antenatal visits.

Lack of physical access to health facilities was implicated among the main reasons for not delivering at health institutions, especially in rural provinces. Any effort to improve institutional delivery in these provinces needs to focus on improving population access to health facilities. The strong positive correlation between higher numbers of antenatal visits and skilled birth attendance further corroborates the need to promote regular and more ANC visits as one of the strategies to increase institutional delivery.

The outcomes of this study suggest that it is important to look beyond the individual when analysing pregnancy-related adverse reactions because women's health is essentially affected by their social environment. Studies that delineate neighbourhoods as rural or urban do not bring out the significant differences that exist among areas classified demographically as rural and urban. This is so because challenges faced by people residing in areas marked as urban but congested with financially disadvantaged people, is more risky than a rural neighbourhood that has space for people to walk and mingle around.

### 8.4.1 Recommendations

The results of this study have significant policy indications. The identification of factors that are significantly associated with exposure to high risk pregnancy is a first step. This knowledge now needs to be converted into development of adequate interventions that aim to prevent pregnancy-related adverse reactions.

**Education**

Level of education has an impact on exposure to high risk pregnancy. Several studies have consistently reported an inverse relationship between education and exposure to maternal health risks. Women with no education were found to be more exposed to high risk pregnancy than women post primary education. Improving education among girls, especially beyond primary school, needs to be strongly encouraged. The government of Zambia needs to emulate the Malaysian programme for the improvement of female

education in line with avoidance of early pregnancies or marriages and uplifting the decision making power of women. This resulted in maternal mortality dropping drastically to a minimum level.

**Place of residence**

Urban women were less likely to be exposed to high risk pregnancy compared to rural women. Even though the availability and accessibility of health facilities were not formally investigated in this research, low usage of delivery health utilities in rural areas exposed the women to high risk pregnancy. More research in this area is needed. However, the government, in collaboration with its cooperating partners, should scale up its targets to have health facilities within reach as previous research in Zambia has revealed that many women preferred delivering at home due to the far distance to the health facility.

**Wealth creation to address low socio economic status and poverty**

In this study, household wealth had a very significant impact on exposure to high risk pregnancy, with poor families more likely to be exposed to high risk pregnancy. Increasing the economic status of the population is a long-term country objective and goes beyond the responsibility of the Ministry of Health. Improving quality and access to health services is essential if the most deprived are to benefit. The Ministry of Health should align its plan of action with Zambia's development strategy articulated in its own Vision 2030. Neighbourhood health workers need to be involved in sensitising pregnant women about risks of maternal mortality like short birth interval, risk associated with maternal age and danger signs during pregnancy. To close the gap in exposure to high risk pregnancy between neighbourhoods, strategies should aim at poverty reduction, advancing women's education and skilled birth delivery in deprived neighbourhoods. Improving quality and access to health services is essential if the most deprived are to benefit.

Neighbourhood health workers need to be involved in sensitising pregnant women about risks of maternal mortality like short birth interval, risk maternal age and danger signs during pregnancy. To close the gap in exposure to high risk pregnancy between neighbourhoods, interventions should aim at poverty reduction, increasing women's education and facility delivery in deprived neighbourhoods. Nevertheless, improving

quality and access to health services is essential if the poor are to benefit. The Ministry of Health could align its plan of action to Zambian's development strategy articulated in its own Vision 2030.

**Information about pregnancy-related adverse reactions**

Research has shown that when women are informed about pregnancy adverse reactions during antenatal care they are more likely to avoid actions that expose them to high risk pregnancy. Therefore, neighbourhood health workers need to be involved in sensitising pregnant women about danger signs during pregnancy, delivery and postnatal periods. It is also crucial to scale up the implementation of initiatives such as focused antenatal care and emergency obstetric care as this is likely to yield positive results. More research, nevertheless, is needed to evaluate the quality of antenatal care in Zambia, especially in provinces where high risk pregnancy was found to be high and the percentage of women who delivered at health facilities was low. The findings suggest that future interventions aimed at preventing exposure to pregnancy-related adverse reactions should look beyond the individual because women's health is essentially affected by their social environment.

Studies that classify neighbourhoods as rural or urban do not bring out the significant differences that exist among areas classified demographically as rural and urban. This is so because an urban area with shanties and with overcrowded living conditions is more risky than a rural neighbourhood that has space for people to walk and mingle around. Developmental interventions must be planned equitably in order to balance resources.

## 8.5 Limitation of the study

This study draws on cross-sectional data recorded retrospectively. Due to limitations of the DHS data we did not examine the complete series of factors of maternal mortality. A woman's reproductive status could predispose her to adverse pregnancy outcome - examples such as diabetes, obstetric care data and preeclampsia among others, were available in the DHS.

The maternal death risk factor index being proposed in this study is constrained by insufficient information especially on the use of emergency obstetric care services. The method can be improved by including more data in future surveys. However, I do not envisage these limitations to pose a problem to the study as they may have little or no effects on the results of the study.

Health management information systems in Zambia do not collect individual variables on maternal death and only hospital death is recorded. Due to limited information in the database it was not possible to assign an underlying cause of death or classify maternal death as direct, indirect or incidental.

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**Appendix A: Dissemination Plan**

| S/N | Title | Thesis Chapter | Abstract | Status | Journal | submit |
|---|---|---|---|---|---|---|
| **1** | Status of maternal Mortality in Zambia: Use of Routine Data | Chapter 5 | Analyzed the trends and determinants of maternal mortality from 2011-2013 | Published | 1 | - |
| **2** | Gender Inequality and Maternal Health Risk in Zambia | Chapter 5 | Investigates the effect of gender inequality in exposing women to high risk pregnancy | Published | 3 | - |
| **3** | Risk factors of Pregnancy Related deaths in Zambia | Chapter 5/6 | Determines variations of risk factor of pregnancy related death across the provinces of Zambia | Good Draft | 5,7 | April 2016 |
| **4** | Is Place of residence an Overlooked factor in Exposure to High Risk Pregnancy? | Chapter 6/7 | Analyzed the role of community factors in exposure to maternal mortality risks | Good Draft | 1 | March 2016 |
| **5** | Modern Method for Deriving Provincial Estimates of Maternal Mortality using Demographic and Health Survey Maternal Health Reviews | Chapter 5 | Use of model based method to provide disaggregated information on maternal mortality by provinces | Good draft | 4,5,7 | April 2016 |
| **6** | Risky Sexual Behavior among Women in Africa: Does Economic Empowerment Matter? | - | Examines economic empowerment and risky sexual behaviour among women | Under review | 2 | March 2016 |
| **7** | Living Arrangements and Nutritional Status of Under-Five Children in Sub-Saharan Africa. | - | Ascertain the risk and association between children's living arrangements and their health status | Good draft | 1,8, 9 | June 2016 |
| **8** | Socio-economic and demographic associations with the co-existence of chronic diseases among older adults in South Africa | - | Examine the socio-economic and demographic associations with the occurrence of multi-morbidity among older people. | Good Draft | 1, 6, 8 | March 2016 |

**List of Journals**

1. APS Journal
2. African Journal of AIDS Research
3. Women & Health
4. Demographic Research
5. Journal of Population Research
6. Population Studies
7. African Journal of reproductive Health
8. Southern African Journal of Demography
9. Journal of Family Demography

## Appendix B: Matrix of some reviewed articles

| S/N | TITLE | AUTHOR | JOURNAL | DATA SOURCE | LEVEL OF ANALYSIS | FINDINGS | GAP |
|---|---|---|---|---|---|---|---|
| 1 | Maternal mortality at the Central Hospital, Benin City Nigeria: a ten year review. | Abe, E. & Omo-Aghoja, L.O., (2008) | African journal of reproductive health, | retrospective review of obstetric deaths | Individual level | Sepsis, haemorrhage, obstructed labor and eclampsia were leading direct causes of maternal deaths | Mainly hospital based study |
| 3 | Maternal mortality at the end of a decade: Signs of progress? | AbouZahr, C. & Wardlaw, T., (2001) | Bulletin of the World Health Organization | Data from UN database using direct and proxy indicators | Regional level | Caesarean delivery rates were higher in countries of the Americas than in Africa and Asia. | Only two indicators associated with maternal mortality: births assisted by a skilled health care worker and caesarean delivery. |
| 4 | Skilled Birth attendants: Who is who? a descriptive study of definitions and roles from nine Sub Saharan African countries | Adegoke, A. a. et al., (2012) | PLoS ONE | cross sectional, descriptive study of nine countries | Cadres of health care providers | More than twenty different cadres of health care providers were reported as SBA in the nine surveyed SSA countries | Information about cadres of staff considered to be SBA and which signal functions they provided relied on reports by key informants |
| 5 | Community study of maternal mortality in south West Nigeria: How applicable is the sisterhood method | Adegoke, A. et al., (2013) | Maternal and Child Health Journal | retrospective survey, using structured interviews | Community based | very high maternal mortality ratio in the study setting, much higher than any previously identified | Level of analysis restricted to community based two Local Government Areas of Oyo state |
| 6 | Social determinants of health--a question of social or economic capital? Interaction effects of socioeconomic factors on health outcomes | Ahnquist, J., Wamala, S.P. & Lindstrom, M., (2012) | Social science & medicine | The Swedish National Public Health Survey 2009 | Individual and community based | Poor health status was significantly associated with economic capital and low social capital. | other individual psychological factors not assessed may have effect on observed associations. |

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| 7 | Factors associated with maternal mortality in Sub-Saharan Africa: an ecological study | Alvarez, J.L. et al., (2009) | BMC Public Health | Data from WHO, World Bank, UNICEF and UNDP database 1997-2006 | Regional based | MMR values in SSA were very high and varied enormously among countries | an ecological study, cause effect relationship cannot be inferred to individual subjects |
| 8 | Health inequities, environmental insecurity and the attainment of the millennium development goals in sub-Saharan Africa: The case study of Zambia. | Anyangwe, S.C.E., Mtonga, C. & Chirwa, B., (2006) | International Journal of Environmental Research and Public Health | Country reports for 2000 & 2005 | Country based | all of the indicator attainment levels were worse off in rural than in urban areas | The study focus was not specific on maternal mortality but analysis of MDG targets |
| 9 | Neighborhood socioeconomic disadvantage, individual wealth status and patterns of delivery care utilization in Nigeria: A multilevel discrete choice analysis | Aremu, O., Lawoko, S. & Dalal, K., (2011) | International Journal of Women's Health | 2008 Nigerian Demographic and Health Surveys data | Individual and community based | Higher birth order and young maternal age associated with use of home delivery. Living in a highly socioeconomic disadvantaged neighborhood associated with home birth. | Study focused on utilization of maternal health services not determinants of maternal mortality |
| 10 | Making abortions safe: A matter of good public health policy and practice | Berer, M., (2002) | Reproductive Health Matters | review of published and unpublished sources | Individual based | Transition from high risk to safe abortion demands national policies and abortion training for service providers | Reviewed policy and health provision to make abortion safe not as a risk of maternal death |
| 13 | Ending preventable maternal deaths: The time is now. | Bustreo, F. et al., (2013). | The Lancet Global Health | - | country level | Strategies to reduce maternal mortality need to address more than the clinical causes of death, need to respond to changing demographics and address contextual features | Study focused on a new method to measure and track progress of MDGs only |
| 14 | Saving Mothers' Lives: Reviewing maternal deaths to make motherhood safer: 2006-2008. | Cantwell, R. et al., (2011) | An international journal of obstetrics and gynaecology | Confidential inquiry records | Individual and community | Mortality rate related to sepsis increased and sepsis the most common cause of Direct maternal death. | Study restricted to UK only |

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| 15 | Caesarean morbidity and mortality at Maiduguri, Nigeria. | Chama, C.M., El-Nafaty, A U. & Idrisa, A, (2000). | Journal of obstetrics and gynaecology | Hospital records | Individual level | More than 44% of patients had one or more intra- and/or postoperative complications. Sepsis was the commonest complication. | Hospital based study |
| 16 | Utilization of focused antenatal care in Zambia: examining | Chama, C.M. & Koch, S.F., (2013). | Health policy and planning | Zambia Demographic and Health Survey 2007 dataset | individual- and community-level factors using a multilevel analysis. | Individual and community level characteristics influenced inad-equate use and non-use of ANC in the first trimester; community-level factors were stronger in rural areas. | Study was mainly on utilization of focused ANC visits |
| 17 | Critical gaps in universal access to reproductive health: Contraception and prevention of high risk abortion. | Culwell, K.R. et al., (2010). | International Journal of Gynecology and Obstetrics | Workshop Report | - | unwanted pregnancies lead to high risk abortion accounting for a significant proportion of maternal deaths | Study based on contraceptive and prevention of high risk abortion |
| 18 | Neighborhood and health | Diez, A. V & Mair,C., (2010). | Annals of the New York Academy of Sciences | Census proxies and neighborhood attributes using a variety of approaches | Individual and community | Existing gaps in knowledge and promising new directions in the field are highlighted | Focused on chronic disease outcomes of obesity and mental health not maternal health risks |
| 19 | Integrating health interventions for women, newborn babies, and children: a framework for action. | Ekman, B., Pathmanathan, I. & Liljestrand, J., (2008) | The Lancet, | Systematic review of articles | - | Recommendation for women to have access and use cost effective interventions for maternal, newborn, and child health | Study on effective use of maternal health care from a health systems perspective without considering individual and community factors |
| 20 | Trends in Maternal Outcomes and Utilisation in Zambia: evidence from secondary sources, | Ensor, T. et al., (2010). | - | Zambia Demographic Health Survey (ZDHS) and Health Management Information System(HMIS) | Population | Both DHS and modelled projections suggest that maternal mortality has remained roughly the same for the last 20 years interrupted by a sudden (but not statistically significant) increase around 1998. | Study was a review on trends of maternal outcomes not study of maternal mortality risks |

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|---|---|---|---|---|---|---|---|
| 21 | The human resource for health situation in Zambia: deficit and maldistribution. | Ferrinho, P. et al., (2011). | Human Resources for Health, | secondary data from the payroll of the Ministry of Health and of the National Health Service facilities-2008 | individual | The provincial distribution of personnel showed a skewed staff distribution in favour of urbanized provinces | Based on defict and maldistribution of skilled personnel without including effect on exposure to maternal mortality risks |
| 22 | Higher Education and Health Investments: Does More Schooling Affect Preventive Health Care Use? | Fletcher, J.M. & Frisvold, D.E., (2009). | Journal of Human Capital | High School records followed for past 50 years | Individual and community | Increases in education have the potential to spillover on long-term health choices | Impact of education on preventive care and not on reduced maternal mortality risks |
| 23 | The influence of distance and level of care on delivery place in rural Zambia: a study of linked national data in a geographic information system. | Gabrysch, S., Cousens, S., et al., (2011) | PLoS medicine | Zambian Demographic and Health Survey 2007 and national facility data from the Zambian Health Facility Census 2005 | Individual and community | Only a third of rural Zambian births occurred at a health facility | Study focused on influence of distance to care and place of delivery maternal mortality risks not considered |
| 24 | Tracking progress towards safe motherhood: meeting the benchmark yet missing the goal? An appeal for better use of health-system output indicators with evidence from Zambia and Sri Lanka. | Gabrysch, S., Zanger, P., et al., (2011). | Tropical medicine & international health | Zambian Census of Population and Housing 2000, the Zambian Health Facility Census 2005, the Sri Lankan Needs Assessment 2001 and 2003, and published data on births, health facilities and staffing | Country level | Geographical access in Zambia which is much less densely populated than Sri Lanka was poor, less than half the population lived within 15 km of an EmOC facility. | Study based on assessing EmOC for only two countries Zambia and Sri Lanka |

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|---|---|---|---|---|---|---|---|
| 25 | The Impact of Adequate Prenatal Care on Urban Birth Outcomes: An Analysis in a Developing Country Context. | Gajate-Garrido, G., (2013). | Economic Development and Cultural Change | The Cebu Longitudinal Health and Nutrition Survey (CLHNS) of a cohort of Filipino women who gave birth in the early 1980s | Individual and community | adequate care has a positive impact on birth weight and decreases the probability of poor birth outcome | Study limited to impact of adequate prenatal care on urban birth outcomes |
| 26 | Aetiology of maternal mortality using verbal autopsy at Sokoto, North-Western Nigeria. | Garba, J. & Umar, S., (2013). | African Journal of Primary Health Care & Family Medicine | interviewer administered verbal autopsy questionnaire | Individual level | The major causes of death were haemorrhage, eclampsia and prolonged labour The association between maternal mortality and the absence of antenatal booking and the 'three delays' was pronounced. | Study restricted to individual level, household and community factors not considered. |
| 27 | Maternal mortality in rural South Africa: the impact of case definition on levels and trends. | Garenne, M. et al., (2013). | International journal of women's health | The health and sociodemographic surveillance system (HDSS) from 1992-2010 | Individual level | Mortality increase from direct causes was mainly due to hypertension or sepsis. Mortality increase from other causes was primarily due to the rise in deaths from HIV/AIDS and pulmonary tuberculosis | The study population was not nationally representative hence cannot be generalized. |
| 28 | Maternal mortality in South Africa: An update from the 2007 Community Survey. | Garenne, M., McCaa, R. & Nacro, K., (2011). | Journal of Population Research | 2007 Community Survey | Household level | maternal mortality increased rapidly from 2001 to 2007 due to rise in deaths from HIV/AIDS and PTB | Mainly household study |
| 30 | Maternal mortality for 181 countries, 1980-2008: a systematic analysis of progress towards Millennium Development Goal 5. | Hogan, M.C. et al., (2010). | The Lancet | Database of 2651 observations of maternal mortality for 181 countries for 1980–2008, from vital registration data, censuses, surveys, and verbal autopsy studies. | Country level | Progress made towards MDG 5 and only 23 countries found to be on track to achieve a 75% decrease in MMR by 2015. | The analysis was done at country level. Differences identified include analysis on regional variation which is disguised in this study. |

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|---|---|---|---|---|---|---|---|
| 31 | Pregnancy-related deaths in rural Rajasthan, India: Exploring causes, context, and care-seeking through verbal autopsy. | Iyengar, K. et al., (2009). | Journal of Health, Population and Nutrition | Hospital records of southern Rajasthan from 2002-2003 | individual | Lack of skilled attendance and immediate postpartum care were major factors contributing to deaths | Study based on hospital records |
| 32 | Preventability of Maternal Deaths: Comparison Between Zambian and American Referral Hospitals | Kilpatrick, S.J., Crabtree, K.E. & Kemp, A., (2002). | Obstetrics and Gynecology | Hospital records | Country level | Infection was main cause of death in the Zambian hospital for direct and indirect deaths. Hemorrhage and cardiac intracerebral were the leading cause of direct and indirect deaths respectively in the American hospitals | Study based on comparison of two countries with different settings facility outputs |
| 33 | Maternal morbidity and disability and their consequences: Neglected agenda in maternal health. | Koblinsky, M. et al., (2012). | Journal of Health, Population and Nutrition | Action Research and Training for Health (ARTH) and icddr,b's community data | individual | Inconsistent use of terminologies of maternal morbidities and the methods used for ascertaining these quantitatively | The article only reviewed the existing literature, and was not a study on maternal death factors |
| 34 | Women's education level, maternal health facilities, abortion legislation and maternal deaths: a natural experiment in Chile from 1957 to 2007. | Koch, E. et al., (2012). | PloS one, | National Institute of Statistics data, 1957–2007 | individual | Women's education level modulated the effects of TFR, birth order, delivery by skilled attendants, clean water, and sanitary sewer access. | Focus was on the effect of educational and maternal health policies on reduction of maternal mortality, other key factors of maternal mortality not addressed |
| 35 | Socioeconomic disparities and health: impacts and pathways. | Kondo, N., (2012). | Journal of epidemiology / Japan Epidemiological Association, | The 2001 Japan Survey (CSLC) and Aichi Gerontological Evaluation Study (AGES) | Individual and community | large population had risks of mortality and poor self-rated health that are attributable to income inequality | Study based on general mortality and not factors of maternal mortality |
| 36 | Why resort to illegal abortion in Zambia? Findings of a community-based study in Western Province. | Koster-Oyekan, W., (1998). | Social Science and Medicine, | Records of structured and self-administered questionnaires and FGDs | Community level | Extremely high induced abortion mortality ratio 120/100000 live births | Focus of the study on illegal abortion in just four districts of one province. Key factors of maternal deaths not addressed |

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|---|---|---|---|---|---|---|---|
| 37 | Quality of antenatal care in Zambia : a national assessment. | Kyei, N.N. a, Chansa, C. & Gabrysch, S., (2012). | BMC Pregnancy and Childbirth | 2005 Zambia Health Facility Census and the 2007 Zambia Demographic and Health Survey (DHS) | Facility based | 45 antenatal facilities (3%) fulfilled the optimum ANC service, while 47% of facilities provided adequate service, and the remaining 50% offered inadequate service | Study was more on utilization of maternal health services and risks of maternal mortality |
| 38 | Postpartum health among rural Zambian women. | Lagro, M. et al., (2003). | African journal of reproductive health | Hospital records | individual | 93% of women with symptoms suggestive of a genital tract infection did not seek medical attention | Hospital based study |
| 39 | Linking families and facilities for care at birth: What works to avert intrapartum-related deaths? | Lee, A.C.C. et al., (2009). | International Journal of Gynecology and Obstetrics. | Review of articles | Systematic review | - | The effect of all of the strategies on maternal and perinatal mortality, particularly intrapartum-related outcomes not fully evaluated. |
| 40 | Effect of women's groups and volunteer peer counselling on rates of mortality, morbidity, and health behaviours in mothers and children in rural Malawi (MaiMwana): A factorial, cluster-randomised controlled trial. | Lewycka, S. et al., (2013). | The Lancet | Community based intervention | individual | Community mobilisation through women's groups and volunteer peer counsellor health education improved maternal and child health outcomes in poor rural populations | The study only focused on effect of women grouping on general mortality and not strictly on maternal mortality |
| 41 | Neighborhood effects on an individual's health using neighborhood measurements developed by factor analysis and cluster analysis. | Li, Y.S. & Chuang, Y.C., 2009. Li, Y.S. & Chuang, Y.C., (2009). | Journal of Urban Health, | Taiwan Social Change Survey conducted in 1990, 1995, and 2000. | Individual and community | Relationships between individual health and community characteristics varied by level of education | The study examined how an individual's health varied in different neighborhood contexts |
| 42 | Distance to care, facility delivery and early neonatal mortality in Malawi and Zambia. | Lohela, T.J., Campbell, O.M.R. & Gabrysch, S., (2012). | PloS one, | National Health Facility Censuses, 2007 ZDHS and 2004 MDHS | Country level | Better geographic access and higher level of care were associated with more frequent facility delivery | More on association between distance and neo natal mortality. Maternal morality risks not considered. |

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|---|---|---|---|---|---|---|---|
| 43 | A critical analysis of maternal morbidity and mortality in Liberia, West | Lori, J.R. & Starke, A.E., (2012). | Africa. Midwifery | maternal death and near-miss audit surveys | Individual and community | Maternal mortality and near-miss audits allowed exploration of medical and non-medical factors leading up to a severe complication or maternal death | Study restricted to one rural county in north-central Liberia. |
| 44 | The Human Resource crisis in the Zambian Health Sector – a discussion paper. | Makasa, E., (2009). | Medical Journal of Zambia | Review of articles | Facility level | The human resource crisis is worse and solutions implemented thus far have neither been totally effective nor comprehensive in reversing the trend | Study was on distribution of health workers in facilities not on effect on maternal mortality |
| 45 | Intermittent preventive treatment of malaria in pregnancy: the incremental cost-effectiveness of a new delivery system in Uganda. | Mbonye, A.K. et al., (2008). | Transactions of the Royal Society of Tropical Medicine and Hygiene, | Qualitative Study | Community level | Community-based delivery increased access and adherence to IPT which was cost-effective. | Study was on preventive treatment of malaria in pregnancy on incremental cost-effectiveness than on the effect of maternal mortality risks |
| 46 | National female literacy, individual socio-economic status, and maternal health care use in sub-Saharan Africa. | McTavish, S. et al., (2010). | Social Science and Medicine | 2002-2003 World Health Survey. Multilevel | Regional level | Higher national levels of female literacy reduced income related inequalities in use through a range of possible mechanism. | Relationship with exposure to maternal mortality risks was not extended in this study |
| 47 | Improving the measurement of maternal mortality: the sisterhood method revisited. | Merdad, L., Hill, K. & Graham, W., (2013). | PloS one | 10 Demographic and Health Surveys (DHS) | Regional level | Mortality estimates based on sibling histories obtained from men do not systematically or significantly differ from those obtained from women | Study was on mortality estimates only. Factors causing maternal mortality were not considered. |
| 48 | Factors associated with home deliveries in a low income rural setting-observations from Nchelenge district | Mwewa & Michelo., (2010) | Medical Journal of Zambia, | Qualitative data | Community level | Home delivery was found to be high and women with less education had higher chances of delivering at home | One off study in a rural district difficult to generalize results. |

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|---|---|---|---|---|---|---|---|
| 49 | Facility-based delivery and maternal and early neonatal mortality in sub-Saharan Africa: a regional review of the literature. | Moyer, C. a, Dako-Gyeke, P. & Adanu, R.M., (2013). | African journal of reproductive health | Systematic review of literature | National and Regional | The demonstrated the need to attend to regional differences both across and within SSA nations if facility delivery rates are to be improved to reduce maternal and early neonatal mortality | Was just a review of literature of different countries |
| 50 | Does it Really Matter Where Women Live? A Multilevel Analysis of the Determinants of Postnatal Care in Nigeria. | Ononokpono, D.N. et al., (2013). | Maternal and Child Health Journal | 2008 Nigeria Demographic and Health Survey | Community level | Significant variations in receiving postnatal care exist across communities | Study focused only on postnatal care other risk factors of maternal mortality not considered |
| 51 | Barriers to Uptake of Emergency Obstetric and Newborn Care Services in Sierra Leone : A Qualitative Study. | Oyerinde, K. et al., (2012). | Community Medicine & Health Education | Qualitative study | Community level | Abolishment of user fees, improvements in both the quantity and quality of health care providers and rehabilitation of health facilities will be needed for Sierra Leone's progress toward its MDG 4 and 5 targets. | This study was more of a needs assessment on improvement of uptake of emergency and newborn care (EmONC |
| 52 | High risk abortion and postabortion care - An overview. | Rasch, V., (2011). | Acta Obstetricia et Gynecologica Scandinavica | Systematic review of articles | - | high risk abortion remains a major contributor to the high maternal mortality worldwide | Only high risk abortion as a risk factor of maternal mortality was reviewed and no other related factors |
| 53 | Maternal mortality: who, when, where, and why. | Ronsmans, C. & Graham, W., (2006). | Lancet | Systematic review of articles | regional | Maternal deaths are not uniformly distributed throughout the world, and obstetric risk is highest by far in sub-Saharan Africa | This is just a review of articles and not the study of risk factors of maternal mortality |
| 54 | Effects of individual and neighborhood factors on maternal care in Cambodia. | Sagna, M.L. & Sunil, T.S., (2012). | Health and Place | 2005 Cambodia Demographic and Health Survey to | Individual and community | Age at birth, parity level, educational attainment, household wealth, occupation, media exposure and counseling about pregnancy complications are significant determinants of pregnancy care. | This study focused on maternal care factors of maternal mortality not addressed |

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|---|---|---|---|---|---|---|---|
| 55 | Linking high parity and maternal and child mortality: what is the impact of lower health services coverage among higher order births? | Sonneveldt, E., DeCormier Plosky, W. & Stover, J., (2013). | BMC public health | DHS data from 10 high fertility countries | Country level | Association between coverage and parity for maternal health interventions was more consistently significant across all countries. | The focus was on effect of high parity, other factors of maternal risks not considered. |
| 56 | Protocol-driven primary care and community linkages to improve population health in rural Zambia: the Better Health Outcomes through Mentoring and Assessment (BHOMA) project. | Stringer, J.S. a et al., (2013). | BMC health services research | Facility survey Medical record Community Survey | community | BHOMA intervention implemented focused upon the delivery of good clinical services | This is a protocol to measurably reduce general mortality rates and not centered on maternal mortality reduction |
| 57 | Impact of Antenatal Care on Maternal and Perinatal outcome: A Study at Nepal Medical College Teaching Hospital. | Tuladhar, H. & Dhakal, N., (2012). | Nepal Journal of Obstetrics and Gynaecology | Facility records | individual | Maternal complications like anemia and pregnancy induced hypertension occurred more commonly in women without ANC | Study not population based but hospital based. |
| 58 | Neighborhood conditions are associated with maternal health behaviors and pregnancy outcomes. | Vinikoor-Imler, L.C. et al., (2011). | Social science & medicine | Street audit data with five years of birth records data from four counties in North Carolina (NC) | community | High levels of physical incivilities and certain neighborhood conditions were associated with all adverse pregnancy outcomes | Level of analysis restricted to community, individual and household not considered |
| 59 | Factors affecting utilization of skilled maternal care in Northwest Ethiopia: a multilevel analysis. | Worku, A.G., Yalew, A.W. & Afework, M.F., (2013). | BMC international health and human rights | facility and population-based survey | Regional | A significant heterogeneity was observed among clusters for each indicator of skilled maternal care utilization. | The study was not specific on maternal mortality risks but utilization of skilled maternal care |
| 60 | Understanding global trends in maternal mortality. | Zureick-Brown, S. et al., (2013). | International Perspectives on Sexual and Reproductive Health | vital registration data or from a hierarchical or multilevel model | Global and National | The annual number of maternal deaths worldwide declined by 34% between 1990 and 2008, from approximately 546,000 to 358,000 deaths | Study done to assess global trends in maternal mortality and not to address determinants of maternal mortality |
| | | | | | | | |

## Appendix C: Proof reader's Certificate

16/09/2016

To whom it may concern

I edited Pamela Chirwa's PhD dissertation.

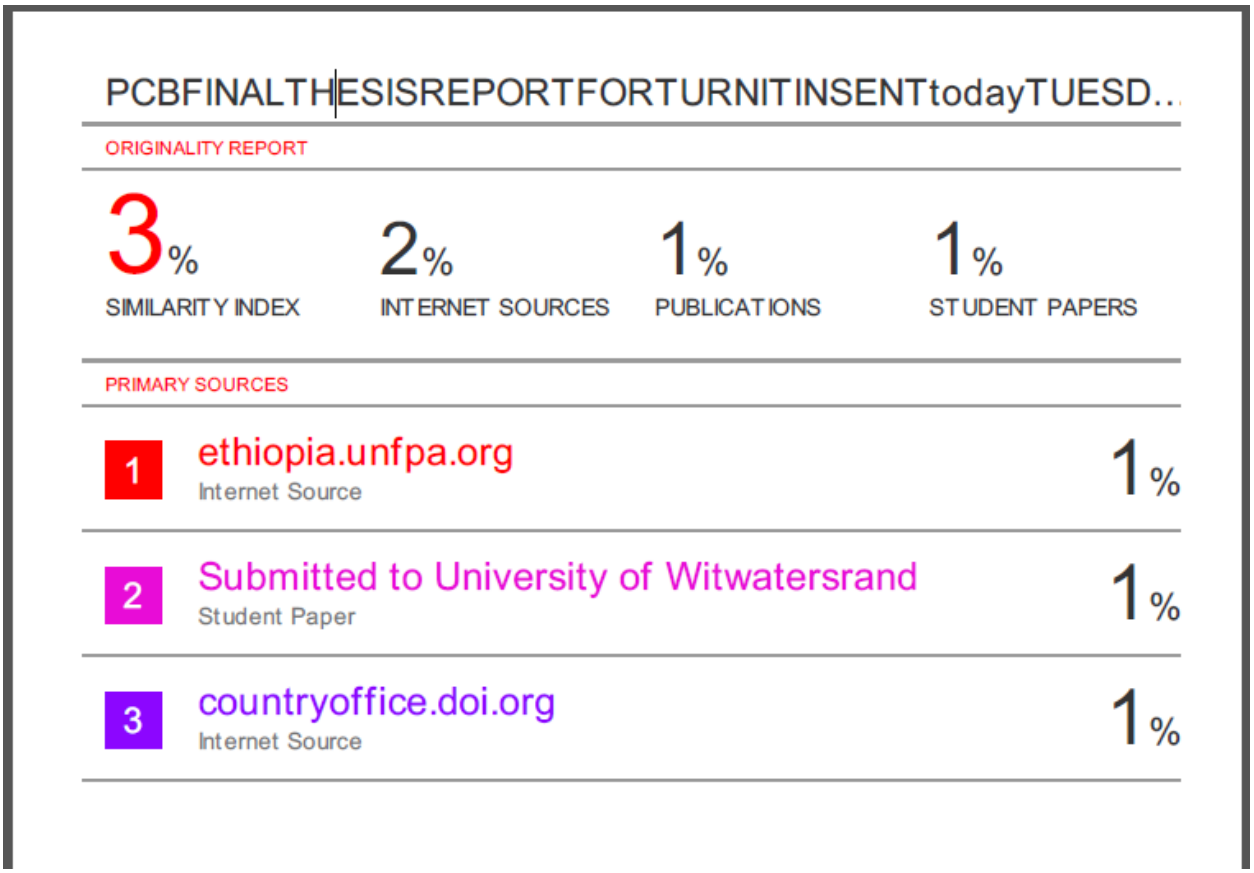
I assure you of my reliability and professionalism.

Warm regards

--

Diana F Henning
Cape Town
South Africa
Tel: 0823354651

**Appendix D: Turnitin Report**



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ORIGINALITY REPORT

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| 1 | ethiopia.unfpa.org<br>Internet Source | 1% |
| 2 | Submitted to University of Witwatersrand<br>Student Paper | 1% |
| 3 | countryoffice.doi.org<br>Internet Source | 1% |

## Appendix E: Policy Brief

**Dissemination meeting with various stake holders on essence of the model based method in estimating maternal mortality -(HOD-Ministry of Health, District Health Planners, HOD-Ministry of Policy and Planning, Central Statistics Office (CSO) and related NGOs**

**Problem**

Maternal mortality data is not disaggregated by provinces and some studies done in Zambia have rarely included community influence on maternal mortality risks. Moreover, no known study has attempted to use Demographic and Health Survey maternal health indicators to estimate maternal mortality by provinces in Zambia. Yet, analyses of variations within small geographic areas provide a better understanding of the social context in which the risks are high for regional priority interventions. In addition, other researchers (Achia & Mageto, 2015; Stephenson & Elfstrom, 2012) have all posted that inclusion of community level variables is helpful to understand several maternal health outcomes.

**Findings**

In this study we examined the influence of both individual and community-level characteristics on maternal mortality risks in Zambia and presented a new model based method that can help policy planners identify high risk areas and prioritise target settings and help in accelerating the attainment of sustainable development goals.

Our study revealed the existence of some unmeasured factors at community and individual level influencing exposure to high risk pregnancy and demonstrated that community factors are important predictors of exposure to risky pregnancy. Using the MDRFI model, high risk pregnancy was estimated for all regions high prevalence were noted especially in the rural regions. Lack of access and utilisation of health facilities on delivery among women with high risk pregnancy was implicated among the main reasons for not delivering in health institutions, especially in rural provinces. Individual wealth status had a very significant impact on exposure to high risk pregnancy, with disadvantaged women more likely to be exposed to high risk pregnancy.

**Policy Implications**

The lack of an appreciable decline in maternal mortality despite advancement in the amount of strategies in maternal healthcare service delivery reflects partly the approaches employed to

study the subject of maternal health outcomes which more often leads to the implementation of interventions in areas perhaps less at risk. As a result of the lack of data and a dearth of comprehensive and integrated research, intervention programmes most often are designed with limited informed targets or communities for attention. This study recommends the use of the MDRFI model to help ascertain where risks are high. The model used in this study can be used to estimate maternal mortality ratio given information on maternal health of the women at any lowest level.

There is a need to implement strategies at different levels (community, health facility and policy levels) targeting prevention of high risk pregnancy. Prevention of high risk pregnancy through effective maternal health programmes where men should be enlisted as important partners in addressing high risk pregnancy. Awareness programmes need to target the community and acknowledge the role in preventing maternal mortality risks. The amount of variation at community and individual level found in our study indicates the need to adopting community-specific strategies along with identifying and addressing community-level factors affecting the exposure to high risk pregnancy would give better results.

Improving the differential in health outcomes for disadvantaged residents will require addressing the fundamental causes of disparate outcomes as well as a strategic approach to health equity. Mostly, the vast majority of maternal health resources are allocated to the provision of health services, offering health education, and targeting individual behaviors. However, this study supports the need to target resources towards reducing inequalities in social, economic, and environmental areas that contribute to differential health outcomes. It is important to look beyond the individual when analysing pregnancy-related complications because women's health is essentially affected by their social environment.

Increased efforts are needed to penetrate culturally engrained health seeking behaviors such as delay in seeking healthcare until the ailment is imminent. Strategies must focus on changing the mindset of pregnant women or lactating mothers in deciding to seek medical attention.

Community health workers need to be involved in sensitising pregnant women about risks of maternal mortality by initiating proactive counselling and ensuring that such women seek care at health facilities. As a result, improvement in health outcomes would manifest over a period of time.