FACTORS ASSOCIATED WITH PERINATAL MORTALITY IN HAI DISTRICT, TANZANIA

BY

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ABSTRACT

Perinatal mortality is a very sensitive indicator of the health status of a community and it is also highly amenable to interventions.

This community based retrospective case-control study was done to determine cultural, environmental, maternal and foetal risk factors for perinatal mortality in Hai district.

A total of 350 mothers were studied, 121 of whom had perinatal deaths, termed as cases and 229 with no perinatal deaths, termed as controls.

Socio-demographic characteristics in both groups were similar, 14(11%) of the cases and 18(7.9%) of the controls were teenagers. Family socio-economic status was also similar. Poor labour outcome accounted for 47(49.6%) of the deaths and prematurity another 12(19.15%). Most of the deaths 69(68%) occurred during the cold season. Duration of labour was significantly longer in cases than in controls (P=0.0019).

Thirty one (25%) of cases and 28(12.2%) of controls delivered at home or on their way to the health units (P = 0.002). However, 108 (89.3%) of the cases and 203 (88.6%) of the controls were at an hour walking distance to their nearest health units. Deliveries of 27(21.7%) of the cases as compared to 26(11.4%) of the controls were done by untrained personnel (P = 0.01).

Antenatal services utilisation was poorer in mothers who had lost their babies. Nine (7.4%) of the cases had not booked for antenatal services at all. This contrasts sharply with a figure of 2(0.82%) for the controls (P = 0.0016). Twenty four (21.4%) of the cases and 15(6.6%) of the controls booked during the third trimester (P =0.0001). Most of the cases, 89(79.5%) and 182 (79.9%) of the controls had not been investigated.

None of the three basic investigations were done in any of the study cases, and they were done in only two of the controls.

Basic routine antenatal examination was done only in 76 (21.2%) of all mothers in the study ; 17 (15.2%) of cases and 4 (1.7%)of the controls had not being examined at all (P = 0.0018). Twenty seven of the cases (24.1%) and 24 (10.5%) of the controls did not receive any of the routinely given medications which are chloroquine, T.T, ferrous sulphate and folic acid (P=0.002)

Mothers of 87 (71.9%) of the cases and 123 (53.7%) of the controls had severe and extreme physical exertion during pregnancy (P = 0.0014).

Female genital mutilation was done in 51 (42.1%) of the cases and 105 (45.9%) of the controls (P=0.5).

In conclusion, prolonged labour, being attended by untrained person during delivery, few antenatal visits, delayed surgical intervention, severe physical exertion, and place of delivery other than health units were associated with an inreased risk of perinatal mortality.

CONTENTS

Item		Page
Abstract		ii
List of contents		iv
List of figures		v
Acknowledgements		vi
Declaration		vii
Copyright		viii
Abbreviations		ix
Introduction and Review of literature		1
Rationale and Study Objectives		10
Study Design and Methodology		13
Results		22
Discussion		49
Conclusions		59
Recommendations		60
References		61
Appendices:	A. Questionnaire	67
	B. Verbal autopsy form	71
	C. Physical activity form	72
	D. Physical activity score	73
	E. Grading of goitre.	74

LIST OF FIGURES

	Page
Figure 1: Monthly distribution of Perinatal deaths	28
Figure 2: Drinking pattern among mothers in Hai District	30
Figure 3: Perinatal age at which death occurred	47
Figure 4: Distribution of perinatal deaths according to their causes	47

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DECLARATION

I declare that the whole of this work has not been submitted for a degree in any other University.

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ABBREVIATIONS

ABD	Assisted Breech Delivery
AMMP	Adult Mortality and Morbidity Project
ANC	Antenatal Clinic
CI	Confidence Interval
CRCHS	Commonwealth Regional Community Health Secretariat
CSPD	Child Survival Protection and Development
ECSA	East, Central and Southern Africa
IMR	Infant Mortality Rate
IUFD	Intrauterine Foetal Death
LBW	Low Birth Weight
MCH	Maternal and Child Health
MMC	Muhimbili Medical Centre
OR	Odds Ratio
PMR	Perinatal Mortality Rate
RMA	Rural Medical Aide
SD	Standard Deviation
SVD	Spontaneous Vertex Delivery
TBA	Traditional Birth Attendants
T.T	Tetanus Toxoid
UNICEF	United Nations Children's Fund
WC	Water Closet
WHO	World Health Organisation

1. INTRODUCTION AND REVIEW OF LITERATURE

1.1 Introduction

Infant mortality is considered to be a measure of socio-economic development, but perinatal mortality is usually seen as reflecting the health of the women, the health of the newborn (neonatal health) and the quality of health services. It also provides a measure of a country's educational, social and public health system. At present there are two reasons for favouring perinatal mortality rates as the general indicator of health status of the neonate and for women. First, death is a finite event, which unlike illness, can be recorded with certainty. Hence, mortality statistics are more exact than those for morbidity. Secondly, the cause of death is often diagnosed with greater accuracy than the cause for the morbidity[1].

The perinatal period represents a biological continuum during which the causes and determinants of death are substantially the same, regardless of whether the deaths take place before, during or soon after birth. Since perinatal mortality includes still births and deaths in the first week after birth, the concept avoids conflicting judgements as to whether a foetus exhibits signs of life or not and differences in administrative practice regarding whether or not its death should be counted. Perinatal mortality is thus a useful measure of reproductive loss for comparison within and between countries[3].

Of the 12.9 million estimated deaths of children under five years that occurred throughout the world in 1990, it is estimated that one third occurred in the neonatal period[3,4]. In most countries, about half of the perinatal deaths occur during the antepartum or intrapartum period, while the other half occur during the first week of life. WHO has estimated that there are over seven million perinatal deaths each year. Of these, approximately half are early neonatal deaths[4].

1.2 Definition

Perinatal period refers to the time surrounding birth. The perinatal period extends from the gestational age at which the average foetus attains the weight of 1000g (equivalent to 28 completed weeks of gestations) to the end of the seven completed day of life[2].

Although this definition is recommended by WHO and accepted internationally, but with advances in neonatal care, regional difference on the reference weight and gestational age have emerged. In technologically advanced countries like Sweden, the perinatal period has been modified to mean gestation age at which foetus is capable of extra uterine viability. Thus gestational age has been reduced to 22 and the foetal weight to 500gm.

1.3 Causes of Perinatal Morbidity and Mortality.

Some factors that lead to perinatal and neonatal death result from inadequate care of mothers and babies while other factors, such as women's status and nutrition, are deeply rooted in the cultural fabrics of societies. These two kinds of factors interact in ways that are not always well understood. The causes of perinatal and neonatal deaths are often presented as maternal, obstetrical and foetal. The ways in which these different causes affect the risk of death are complex and there is rarely a clear-cut explanation. Causes of perinatal death include poor maternal health, inadequate care during pregnancy, inappropriate management of complications during pregnancy and delivery, poor hygiene during delivery and the first critical hours after birth, lack of new-born care and baby-mother separation after birth. The relative significance of these causes in contributing to neonatal and foetal deaths differs from place to place[2].

The degree to which perinatal and neonatal deaths are associated with maternal complications and maternal deaths is demonstrated mostly by the data which show that

maternal death during labour or delivery almost always also means death for the foetus . If a mother dies after delivery this often leads to death of the infant as well.[5] Most of the infants born by the 500,000 women in the world who die each year during pregnancy or childbirth, will die during the perinatal period[4,6] .Thus, most interventions aimed at lowering perinatal mortality must also address maternal health and social position of women.

WHO estimated that there are 20 million teenage pregnancies every year in the world. Most of these are missed, unwanted, untimed and illegitimate.[5,6] Any unwanted pregnancy whether illegitimate or within marriage has a substantial increased risk.

- Perinatal mortality has strongly been associated with maternal age. Increased risk to perinatal death is mostly seen in teenage and advanced age pregnancies (>34 years)[7,8,9,10,11]. Over one year period the risk of perinatal death attributable to adolescent pregnancies in Cuba rose from 2% to 11%[12]. This observation led the government of Cuba to develop a policy and programmes on prevention of adolescent pregnancies.
- Perinatal mortality is 20% higher in primiparae and 50% higher in multiparae (> 4 pregnancies) compared to those mothers with 2 or 3 pregnancies. Even when adjusted for race, age, and other risk factors, multiparity increases perinatal mortality[13,14].
- The risk of perinatal death among pregnancies preceded by foetal death in North Carolina, U.S.A, was found to be two to three times the rate among those preceded by a full term live birth[15]. Mothers with a previous history of stillbirth also face a risk of having a low birth weight infant[16].

Incomplete educational attainment and ignorance of basic nutritional concepts may lead to sub optimal nutrition of the foetus. Pre-pregnancy weight and weight gain during pregnancy strongly relates to perinatal morbidity and mortality[17]. Infants affected by intrauterine malnutrition are small for date, hypothermic, hypoglycaemic, and vulnerable to infections thus contributing to high perinatal and infant mortality[18,19].

Perinatal mortality rate among non-whites is higher than in whites. Studies done in U.S.A on the deference in socio-economic conditions , birth weight or maturity have not been able to significantly explain the difference. Possible involvement of genetic factors which account for the difference in birth weight between the two groups can be a possible explanation[20].

The early recognition of high risk pregnancies is the major step in the prevention of perinatal mortality. Analysis of 315 perinatal deaths in U.S.A in 1982 indicated that 24% of the 135 stillborn and 27% of early neonatal deaths were preventable by available medical means[3]. With time, as social and economic circumstances improve and health infrastructure develop, perinatal and infant mortality declines[21]. In a number of countries perinatal mortality has decreased by half over a period from 1965 to 1980. Improvement in the coverage of perinatal and delivery services appear to be an important factor in this decline[22]. The improvement in antenatal and delivery service in Mauritius contributed to the reduction of perinatal mortality in that country from 85% to 32%[3]. The significant difference in perinatal mortality rates between Kilimanjaro (58/1000) and Morogoro (91/1000) regions in Tanzania is assumed to be due to improved antenatal and delivery services in the former[23]. Morbidity and mortality is higher in the pregnant women who fail to obtain adequate medical care early in pregnancy.

Early and adequate pre-natal care has been associated with reduced risk of low birth weight, prematurity, breech presentation, toxaemia, and caesarean section[24,25,26,27,28].

Infections during pregnancy can be directly harmful to the foetus or can be associated with foetal wastage. For example, severe malaria is the commonest cause of premature delivery at Muhimbili Medical Centre in Tanzania[29]. The same findings have been reported in most of the tropical countries where malaria is highly endemic. Some of the

intrauterine infections such as syphilis are commonly associated with high perinatal mortality. In Zambia and Ethiopia, syphilis accounts for 30-40% of all stillbirths[26].

Diabetes mellitus in pregnancy especially when not properly controlled is associated with early neonatal hypoglycaemia with consequent perinatal death[30].

Health care services is not always available, and quality care may be poor because birth attendants are not always adequately trained to deal with the basic needs of the new-born and in the management of basic problems or disease which may occur. Infections caused by poor hygiene during birth may result in death of the new-born soon afterwards.

Some drugs may be dangerous for the growing foetus. For instance thalidomide can cause severe congenital malformations, while potassium iodide can cause congenital hypothyroidism and so forth[31].

Heavy alcohol consumption has been associated with increased mortality. This is partially due to nutritional deficiency which is a common finding in alcoholics[32]. Women who smoke heavily give birth to significantly lower birth weight infants compared to non smokers. However, there is not much known about the role of raw tobacco (chewing or sniffing) on the birth weight and subsequent perinatal mortality and morbidity[32,33].

Environmental factors such as weather, pesticide and iodine deficiency play an important role in perinatal morbidity and mortality[34,35,36].

Deliveries during cold seasons have been associated with increased perinatal deaths and this has strongly been associated with hypothermia. A field study in Malawi on hypothermia and breast feeding confirms that even small changes in the neonatal body temperature are detrimental[37].

The health and well being of the new-born infant is based on four principles of care, a non traumatic and clean delivery, initiation of spontaneous respiration, maintenance of

body temperature and initiation of breast feeding[38]. This is basically a knowledge that everyone attending a delivery should be acquainted with. In a two year analysis of over 21,000 neonatal deaths in Argentina, it was estimated that 70% of those deaths could have been prevented or greatly reduced with appropriate delivery care. The same observation was seen in Cali, Columbia[39].

Fortunately, most foetuses reach term in good health and are well equipped for extra uterine life. If they die or become permanently damaged it is because of obstetrical complications. Poor management of delivery causes asphyxia or trauma, and with poor neonatal care these babies end up dying during the perinatal period.

Organisation and provision of perinatal and delivery care is important in reducing perinatal morbidity and mortality. WHO estimates that only 55% of all births in the world are attended by trained personnel. Even fewer deliveries take place in an institution. In 1983, nearly 58 million women in the world were delivered by TBAs, family members or delivered on their own[4]. Within the country there is wide variation of categories of trained staff providing perinatal and delivery care. Training of traditional birth attendants in clean delivery techniques in Bangladesh was associated with 70% reduction in total neonatal mortality and over 75% reduction in neonatal tetanus mortality[40]. In Mwanza Rural district in Tanzania, perinatal mortality rate was found to be three times higher in home deliveries than that in dispensary or hospital deliveries[41,42].

Some of the traditional beliefs and practices have been associated with increased mortality and morbidity. Prolonged labour due to delay in seeking skilled medical attention and local oxytoxics use have been associated with high incidence of ruptured uterus and sepsis. Female genital mutilation is associated with prolonged labour and denying babies of colostrum is associated with delayed initiation of breast feeding and consequent neonatal hypoglycaemia and possible perinatal death[6].

In most cases, the cause of a perinatal death is multifactorial. However, emphasis is on the causes that are preventable. Many maternal factors such as hypertensive disorders and infections as well as some obstetric complications such as abruptio placenta cause preterm birth[43]. Multiple pregnancies often result in preterm births, and consequently low birth weight. Although low gestational age and low birth weight cannot be categorised as causes of foetal death, such babies do not tolerate the processes of birth well. Asphyxia kills or damages preterm foetuses during or immediately after birth more frequently than term foetuses [44,46]. In addition, the abnormal presentation of many preterm foetuses may contribute to birth asphyxia and trauma.

Preterm babies do not adapt well to extra uterine life. This is because they often have difficulties in starting breathing, and they are very susceptible to cold injury which can easily be fatal[46]. Infections that cause preterm birth can also cause death in preterm infants. Preterm birth, one of the commonest reasons for perinatal death, demonstrates how different factors combine to result in a perinatal death.

1.4 Strategies for prevention of perinatal morbidity and mortality.

In developing countries, priority has been given to the reduction of post-neonatal and early childhood mortality in the erroneous belief that perinatal mortality cannot be influenced by public health measures. Thus, decreases in perinatal and neonatal mortality often lags behind a decrease in infant mortality in general. In many countries today, the newborn remains neglected by the health care system and the interventions to reduce perinatal and neonatal deaths are of low priority. Nevertheless, effective public health actions and inexpensive clinical interventions can reduce perinatal and neonatal deaths and thus result in an improvement in infant health.

Perinatal mortality within a country is a very sensitive indicator of the impact of interventions programmes. It is thus a useful indicator for monitoring changes in the

quality of care in different populations and areas in the country[47]. Efforts to reduce this should start with prospective and retrospective community diagnostic surveys, to identify the risk factors and their contribution to the problem. The community surveys are of particular importance to find out the most important factors.

It is normally difficult to institute multiple intervention programmes but when the most important factors are known, the intervention measures become easier and effective.

Tanzania, like most of the developing countries, has a high perinatal mortality rate. In the 1987 survey, PMR was estimated to be 91 and 58 per 1000 total births in Morogoro rural and Hai districts respectively[23]. Not much is generally known about the associated factors. Most factors reported from other countries are incomplete because they are normally derived from institution based studies [18,24,43]. In Mwanza Tanzania, the PMR was 68/1000 in the community surveys as opposed to 96/100 from the hospital statistics[41]. This clearly shows the disparity between institutional and community based perinatal studies.

The magnitude of the problem of perinatal mortality is normally visible when taken in terms of proportions and percentages. These show to what extent perinatal mortality contributes to the general mortality. For instance, with low infant mortality rate (IMR) the proportion of perinatal mortality is high indicating that it is still an unsolved problem. Although PMR in Hai is lower than in Morogoro and Dar es Salaam, the percentage contribution to under 4 years mortality was 38%, while in Morogoro it was 29% and in Dar es Salaam 27%[48].

1.5 Verbal autopsy tool

Information on causes of death is regarded as very important in policy making, planning, monitoring and evaluation of health programmes[49,50] It is very unfortunate that most of the deaths in the developing world occur at home[48,57]. More perinatal deaths as compared to deaths in any other age groups occur at home.

Neonatal death is not recognised or accepted as a problem in many societies, in large part because they are so common that at an emotional and cultural level, individuals, families and societies have adapted by not recognising the completion of the birth until the new-born survives an initial period of one week to 40 days or even beyond. It is because of these reasons that perinatal deaths are extremely under reported[2]. Verbal autopsy is of particular importance in identifying cause specific perinatal deaths. There are several studies that have tried to validate the use of verbal autopsy both in adults and children[52,53,54,55,56] and therefore verbal autopsy has been accepted as a tool for identifying causes of death.

Identifying the causes of perinatal deaths and also identifying the important risk factors associated with perinatal mortality, is the first and most important step towards reducing the rate of preventable perinatal deaths.

2. RATIONALE AND OBJECTIVES

2.1 RATIONALE

Poor antenatal, intrapartum and postpartum care, and low socio-economic conditions, are main factors that have been associated with perinatal mortality, especially in developing countries[6]. Intervention in the mentioned factors normally brings about a rapid and significant reduction in perinatal mortality.

In Tanzania studies done in Kisarawe and Kibaha districts show that the main factors related to perinatal mortality are poor antenatal and natal care, and low socio-economic conditions[57]. Despite a better health infrastructure and better socio-economic conditions in Hai district, perinatal mortality is considerably high[48]. It would be quite useful to find out factors other than poor antenatal and natal care, and low- socio-economic conditions that have not been addressed by the existing health intervention programmes like Child Survival protection and development programme (CSPD).

This study aims at evaluating these factors so that advice can be given on intervention methods that are effective and feasible.

HYPOTHESIS

1. Mothers who lost their children during the perinatal period have had more physical, physiological and psychological stress than those who did not.

2. There are socio-demographic differences between mothers who lost their children in the perinatal period and those who did not.

3. Mothers who had perinatal death had high risk pregnancies, and those who did not have perinatal death had normal pregnancies.

4. Cultural practices that have an effect on the outcome of pregnancy and child birth were more practised by mothers who had encountered perinatal death than those who did not.

5. Mothers who had perinatal death did not have the same access and quality of health services (medical, antenatal, natal and neonatal) like those who did not have perinatal deaths.

2.3 OBJECTIVES

Broad objective:

To determine factors associated with perinatal mortality in Hai district.

Specific objectives:

1. To determine socio-demographic and socio-economic factors related to perinatal mortality.

2. To identify environmental factors, cultural practices and their effect on perinatal mortality.

3. To identify maternal and pregnancy risk factors associated with perinatal mortality.

4. To evaluate the effect of provision of medical, antenatal, delivery and neonatal care on perinatal mortality.

5. To determine foetal factors associated with perinatal mortality.

3. MATERIALS AND METHODS

3.1 STUDY AREA: HAI DISTRICT

Hai district lies on the south-western slopes of mount Kilimanjaro. It borders Rombo district on the north-east, Moshi Rural district on the east, Kiteto district on the south, Arumeru district on the west and Monduli District on the north west. It has an area of 13,000 sq. kilometres and a population of about 260,000 people. The rate of population growth is 2.8 percent per year. There are over 38,200 households with an average family size of 5.2 people (1988 census).

About 54.3% of the population are adults and children above 15 years of age. 92.5% live in rural areas and 7.5% live in urban settlements.

Geographically the district falls into three zones:

a) The lowland zone which lies at an altitude of 750 to 1000 metres above sea level with scanty rainfall (approximately 325 mm per year), warm temperatures (between 20-22^{o}C) and sparse population (about 70 people per square kilometre).

b) The midland zone which lies at an altitude of 1000 to 1600 metres above sea level with adequate rainfall (approximately 1560 mm per year), moderate temperatures (between 15-17^{o}C) and a dense population (about 150-600 people per square kilometre).

c) The highland zone which lies at an altitude of over 1600 metres above sea level with heavy rainfall, cool temperatures, mountain forests and grasslands. People do not live in this zone. The zone constitutes the largest water reservoir and forest reserve in Kilimanjaro region. Multiple springs and riverines flow from this zone, and water both the midland and the lowland zones before they empty into the Pangani river basin.

Administratively the district is divided into 4 divisions, 11 wards, 61 villages and 3,818 ten cell units (i.e. units of 10 households). These provide channels of political and technical support to the population.

Agriculture, livestock keeping, dairy farming, commercial mining activities, and cottage industries are the main economic activities. Coffee, bananas, maize and other grain crops, dairy products and livestock are the main sources of income. Coffee, bananas, and dairy animals are raised mainly in the midland zone, while maize and other grain crops as well as livestock, are produced mainly in the lowland zone. People migrate from the midland zone to the lowland zone each year to grow maize and other grain crops. Underpinning these activities is an infrastructure of 710 kilometres of road, a railway line connecting the municipalities of Moshi and Arusha, and an international airport, The Kilimanjaro International Airport. Unfortunately, most roads are unpaved and impassable for vehicles during the rainy season.

At present, the district has 139 primary schools with a total population of 39,618 pupils, 13 secondary schools (both public and private) with a total population of 4,880 pupils and five post primary technical schools with a total population of 720 students. About 95% of school-age children go to school and about 96% of the population is literate (1988 Census). The 5% of school-age children who do not go to school are mainly children of Masai tribesmen who use their youngsters to look after cattle.

The district has two hospitals, four health centres, (one in every division), 39 dispensaries and 61 village health posts. These provide curative, preventive and health promotion services. About 84.5% of children below the age of five years are vaccinated against six major communicable diseases (EPI evaluation report 1991/1992).

Water supply is plentiful in the district especially in the highland and midland zones but in most areas the water is heavily polluted with microbes, toxic minerals and agricultural chemicals and is unsafe for human consumption.

Wood is the main source of energy, accounting for about 95% of the total energy consumed in the district. Because of the rapidly growing population, demand for fuel wood is rising sharply and people are being forced to cut down trees and encroach on the

highland forest reserve. This has had very deleterious effects on the environment. Thirty-six of the 61 villages have electricity, but the use of this source of energy is limited because of its high cost. A few households use biogas.

The study area included all four of the divisions in the district, namely: Lyamungo, Machame, Siha and Masama divisions. It includes both the lowland and midland zones, heavily and sparsely populated areas, areas with adequate water supply and areas with poor water supply, areas with reasonable health facilities and areas with poor health facilities, areas with easy accessibility and areas with poor accessibility. The poorly served and sparsely populated villages are Mtakuja, Sanya sation, Rundugai, Kawaya, Kikavu Chini, Mijongweni, Longoi, Mbatakero, Shirimgungani, Shirinjoro, Kimashuku, Kwa Sadala, Kwere, Bomang'ombe, and Mungushi.

3.2 STUDY DESIGN

This was a community based retrospective case-control study involving the whole of Hai district. Data collection was done between August, 1996 and January, 1997. Cases were all perinatal deaths that occurred during one year study period between July 1st, 1995 to June 30th, 1996. Controls were live births within the same study period.

3.3 Sample size estimation

The estimation of sample size was based on the assumption of PMR of 60/1000 live births[23], with 2 controls for every case. An assumption of 5% exposure in the controls and 15% exposure in the study cases was made, with an Odds ratio of 3, a power of 80%, 95% confidence level, and a level of significance of 5%. The minimum estimated sample was 339, comprising of 113 cases and 226 controls.

All calculations were done using Epi-Info 6 software for calculation of sample size in unmatched case-control studies.

3.4 Recruitment and Data collection

Previous report from Adult Morbidity and Mortality Project (AMMP) reported a total of 82 perinatal deaths in the 1993/94 survey. AMMP project covers only three of the four divisions namely Lyamungo, Machame and Masama. Siha, the forth division is not included in the AMMP project.

Assuming that the proportion of perinatal deaths in the area remained the same through to 1995/96, Siha division was included in this study in order to achieve the required estimated sample size. Furthermore, because of the diversity of several factors in the district such as weather, economic activities, cultural backgrounds, road accessibility, distribution of health facilities and population density between lowlands and highlands, it was agreed to include all four divisions for better comparison. Prior to recruitment, one week training of the research assistants and pre-testing of the questionnaire was done.

All perinatal deaths which occurred during the one year study period, (July 1st, 1995 to June 30th, 1996) were recruited as cases. Two live babies in the immediate neighbourhood where prenatal death was reported and delivered within the same one year period as the cases, were selected and recruited as controls. Identification of the perinatal deaths was done by ten cell leaders by doing house to house visits. During the visits, all living babies who were delivered within the same period were also identified. The identified perinatal deaths and the living babies were reported to the enumerators. There were three enumerators in every village who were selected from RMAs, MCH Aides and primary school teachers. Enumerators had two main tasks; first was to select and identify the controls who were selected among the identified living babies, and secondly to visit the families of cases and controls and arranged suitable days and time of interview.

Recruitment and data collection were done by the principal investigator and six other research assistants working as Senior Medical Assistants. One of the research assistant was an Assistant Medical Officer. The interviews were done in the presence of enumerators as facilitators, and the information entered in a pre-tested structured questionnaire (Appendix A)

Respondents were preferably biological mothers in the presence of their spouses. In case of a maternal death or prolonged absence, the closest person such as grandparent or in-law was interviewed. Antenatal cards, when made available, were used to elicit information regarding weight gain, examination, medications and investigations which were done during the visits. Also the cards gave information on labour progress and outcome, birth weight and sometimes Apgar score. Verbal autopsy (Appendix B) was used to determine the most probable cause of death. Mothers were asked about symptoms and signs observed in the baby or problems which developed during pregnancy. Information from hospital records when available was used to supplement the information from the respondents. After the recruitment of a case, controls were identified and recruited. When the immediate control was not available the consecutive family with eligible baby was chosen.

Physical activities done by mothers during pregnancy were categorised in five groups (Appendix C). Arbitrary scoring of physical activities according to the severity was also done (Appendix D).

Weight of the mothers in kilograms was measured using bathroom scales, and height in centimetres using height sticks designed for the same purpose. Examination for goitre was done and grading done accordingly (Appendix E). Mothers were asked the estimated gestation age in months of the cases and controls at birth. The recruitment exercise was done throughout the week including weekends. The most preferred day was

Sunday because it is not a working day and most key family members were at home. In several instances, more than one visit had to be made in order to recruit a case or control.

Assistants used motorcycles provided by AMMP, and the principal investigator used a car provided by CSPD programme for recruitment and general supervision. Most enumerators used bicycles provided by the AMMP and CSPD programmes.

3.5 Monitoring and Supervision

Supervision was done weekly by the principle investigator. Review of the questionnaire and verbal autopsies were done every fortnight by the principle investigator and assistants (interviewers), and some of the problems that emerged were solved. For instance the understanding of the question eight about previous history of still births, to others meant the inclusion of the index outcome, while it actually meant death other than the index death. In such cases clarification was made and responses harmonised.

3.6 Statistical Analysis

Data entry and cleaning was done using DBASE IV and Fox-pro computer programmes. Statistical analysis was done using EPI-Info 6 and SPSS Programmes. Statistical significance testing of difference between means and proportions was done using student t-test and Chi-square test respectively. The level of significance was 0.05 i.e. P-values of <0.05 indicated a significant association. When the expected values were too small, Fisher's exact test was used. Multivariate logistic regression analysis was used to control for potential confounding factors. All variables with significant associations in the univariate analysis were entered, one at a time while checking the contribution of each variable to the β coefficient.

3.7 Ethical Clearance and Permission to do the study

Ethical clearance for carrying out this research was obtained from the College Higher Degrees, Research and Publications Committee of MUCHS. Thereafter, permission for doing the study was obtained from Hai district authorities and respective local village leaders. An informed consent for participation was obtained from the individual parents or relatives.

Mothers who we thought had problems that needed further medical attention, such as recurrent foetal wastage, were advised to see the Assistant Medical Officer, at Kibongoto hospital who was also involved in the recruitment exercise for further management. Whenever possible, health education was given after the interview and it was based on individual problems such as poor antenatal service utilisation and home deliveries.

a) Inclusion criteria:

All identified perinatal deaths which occurred from July 1st, 1995 to June 30th, 1996 and for which parent's consent was obtained, were recruited as cases. Controls were two immediate neighbouring live babies who were delivered within the same time frame.

b) Exclusion criteria

i) All perinatal deaths which were preceded by another perinatal death which occurred consecutively within the same one year study period.

ii) All controls that were preceded by a perinatal death which occurred within the same study period

iii) Multiple births with a sibling who died in the perinatal period

3.9 Limitations of the study

(a) The study was done during the harvesting period and despite all the efforts and several visits, we were unable to recruit a few cases and controls.

(b) In the lowlands, families live far from each other, and in a few cases it was only possible to recruit one control and so the ratio of 1:2 for case: control as expected was not reached. Instead the obtained ratio was 1:1.9.

(c) Seven percent of the population live in urban settlements of Sanya Juu and Bomang'ombe. Some of them live in rented houses or rooms and so a few of the determinants of socio-economic status like housing, toilets and water source did not represent the true household socio-economic status.

(d) A few mothers had misplaced their antenatal cards, and among them, very few remembered their weight gain during pregnancy.

(e) Drinking of local brew (mbege) is normally done using traditional calabashes of variable sizes and therefore, it was difficult to estimate the exact amount taken. The estimation was done by comparing with a standard, a one or two litre container also used for drinking local brew (mbege) especially in public places.

(f) Goitre status after delivery did not represent the true status during pregnancy because some deliveries took place several months before the interview.

Operational Definitions

Household

People living together, and sharing the same meal

Household Socio-economic status

This is the evaluation of economic welfare of the family. Parameters used were; type of houses, type of roofing, presence of electricity, sources of water, type and use of toilets, and possession of dairy cattle.

Delivery Intervention

Active intervention of labour when spontaneous vertex delivery is no longer anticipated. It includes: instrumental delivery, abdominal delivery, destructive surgery, and assisted breech delivery.

Single mothers.

These are mothers who have never been married. They live alone forming a household or may live with parents, relatives or other guardians.

Size of the baby

This was an arbitrary categorisation of birth weights into small, medium and large, corresponding with a birth weight of less than 2500gms, 2500gms to 3500gms and more than 3500 gm respectively. This is done in order to acquire uniformity between known and unknown birth weights.

Adequate clothing / warmth

Basically regarded as drying of the baby immediately after delivery, covering with at least three layers of cotton cloth or a layer of blanket. It also means placing a baby covered with the mother and placed in contact with her.

Child spacing

Spacing between two consecutive deliveries. In the context of this study, it means spacing between the index baby or perinatal death and the previous delivery.

4. RESULTS

A total of 353 cases and controls were enrolled during the study period. During analysis, the most important part of the history was missing in three controls and so these were excluded from analysis. Therefore, the total valid study population was 350 composed of 121 cases and 229 controls.

4.1. Socio-demographic characteristics

The general characteristics of the study population as shown in table 1 were comparatively similar, 82.6% of respondents in the cases and 94.8% in the controls were biological mothers. Other respondents were biological fathers, grandparents and in-laws in 15 (12.4%) of the cases and 12 (8.2%) of the controls. The mean age was 27 years for both cases and controls, and the mean height was 154 cm and 156 cm for the cases and controls respectively. The mean parity for the cases was 2.75 and for the controls 2.84. Twenty one (17.4%) of the cases and 26 (11.4%) of the controls were either single, separated or widowed. Seventeen (80.9%) of 21 cases and 22 (84.6%) of 26 controls were single mothers forming a major group of the unmarried.

The literacy rate of the mothers and their spouses was above 96% for both cases and controls. The differences in the mean height and in the marital status between cases and controls were was not statistically significant (P = 0.08 and 0.16 respectively).

Table 1: Maternal Characteristics of cases and controls

Characteristics	Cases n=121	Controls n=229	p-value
Respondent Relation-Biomother	106(87.6%)	217(94.8%)	0.18
Mean Age ±SD [range]	27[14-42]	27[15-42]	0.16
Mean Height ±SD [range]	154[148-175]	156[145-175]	0.08
Mean Weight±SD [range]	57.9[44-84]	57.6[48-75]	0.08
Mean Parity ±SD [range]	2.75[1-19]	2.84[1-9]	0.13
Married	100(82.6%)	203(88.6%)	0.16
Ever been to school (wife)	118(98.5%)	226(98.7%)	0.15
Ever been to school (spouse)	117(96.7%)	226(98.7%)	0.15

Table 2 shows relationship between maternal age and perinatal outcome. Age distribution is similar in both cases and controls. Fourteen (11.54%) of the cases and 18 (7.9%) of the controls were teenagers. Twenty four (19.8%) of the cases and 37 (16.3%) of the controls were mothers more than 34 years of age.

In a further separate analysis, teenage and advanced age pregnancy were not significantly associated with poor perinatal outcome (p = 0.25 and 0.08 respectively).

Table 2: Age distribution of cases and controls

Age (yrs)	Cases n=121(%)	Controls n=229(%)	Total n=350(%)
14 - 19	14(11.54)	18(7.9)	32(8.9)
20 - 24	36(29.8)	63(27.5)	99(28.3)
25 - 29	27(22.3)	70(30.6)	97(27.7)
30 - 34	20(16.5)	41(17.9)	61(17.4)
>34	24(19.8)	37(16.2)	61(17.4)

$\chi^2 = 5.42, \quad p = 0.36$

Table 3 shows relationship between different determinants of socio-economic status with perinatal outcome.

The household socio-economic status were almost similar in both cases and controls. In general, most cases and controls live in good socio-economic conditions. More than 85% of the houses are reliably roofed, most of them with iron sheets and a few with tiles. Piped water was used by 50 (41.3%) of the cases and 95 (41.5%) of the controls. The other important sources of water were streams and ponds and were used by 71(58.7%) of the cases and 135(58.5%) of controls.

The excreta disposal conditions were comparatively good. Two hundred and eighty nine (82%) of the families in both groups had pit latrines which were sheltered. While 56 (17%) families had pit latrines that were not sheltered, four families had no toilets at all.

Dairy cattle were owned by 55 (45.5%) of the cases and 98 (42.8%) of the controls. The main economic activity in more than 85% of the families of both cases and controls was farming.

Table 3: Household socio-economic status

Factor	Cases n = 121(%)	Controls n = 229(%)	OR	C1	p-value
1. House					
clay/ mud	73(60.3)	152(66.4)	0.77	0.47-1.23	0.3
- brick/stone/wood	48(39.7)	77(33.6)			
2. Roof					
- grass/ mud	18(14.9)	28(12.2)	1.25	0.63-2.50	0.59
- iron sheets/ asbestos/tiles.	103(85.1)	201(87.8)			
3. Electricity					
- yes	15(12.4)	38(16.6)	0.71	0.35-1	250.37
- no	106(87.6)	191(83.4)			
4. Source of water					
- pipe(home/public)	50(41.3)	95(41.5)	0.99	0.6-1.60	0.93
- others(stream/pond etc.)	71(58.7)	135(58.5)			
5 Toilet					
- WIC/pit sheltered	100 (82.6)	189 (82.5)	1. 01	0.69 - 1.47	0.902
- others and none	21 (17.4)	40(17..5)			
6. Dairy cattle					
-yes	55 (45.5)	98 (42.8)	1.11	0.8-1.43	0.71
- no	66(54.5)	131 (57.2)			

4.2. Environmental factors

Goitre:

Only three cases and one control were found to have grade 2 goitre. However, the numbers were too small for statistical significance testing.

Season

Figure 1 shows the monthly distribution of the deaths. Most of the deaths, 69 (57.0%) occurred during the cold rainy season which stretches between April and August. The month of July alone had 25 (20.7%) of all the deaths and this was by far the highest monthly figure.

Fig. 1 Monthly distribution of deaths.

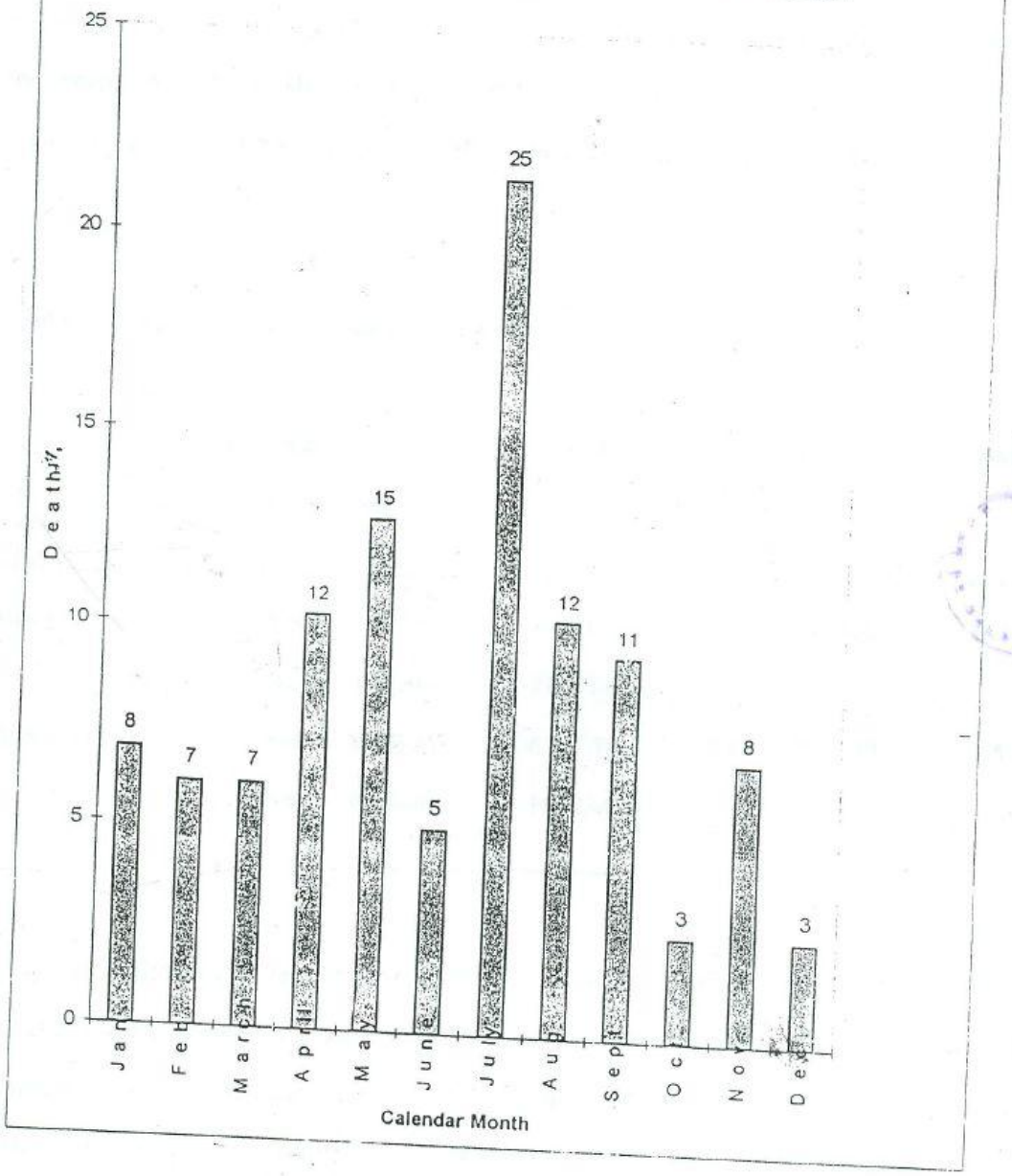


Table 4 shows the frequency of sniffing and chewing of raw tobacco by mothers, and smoking by their spouses. Twelve (9.9%) of cases and 10 (4.4%) of controls were chewing or sniffing raw tobacco (p=0.04). There was no history of smoking among all the recruited mothers. However, smoking by the spouses was observed in 38 (31.4%) of the cases and 63 (27.5%) of the controls . They smoked an average of 4 cigarettes a day.

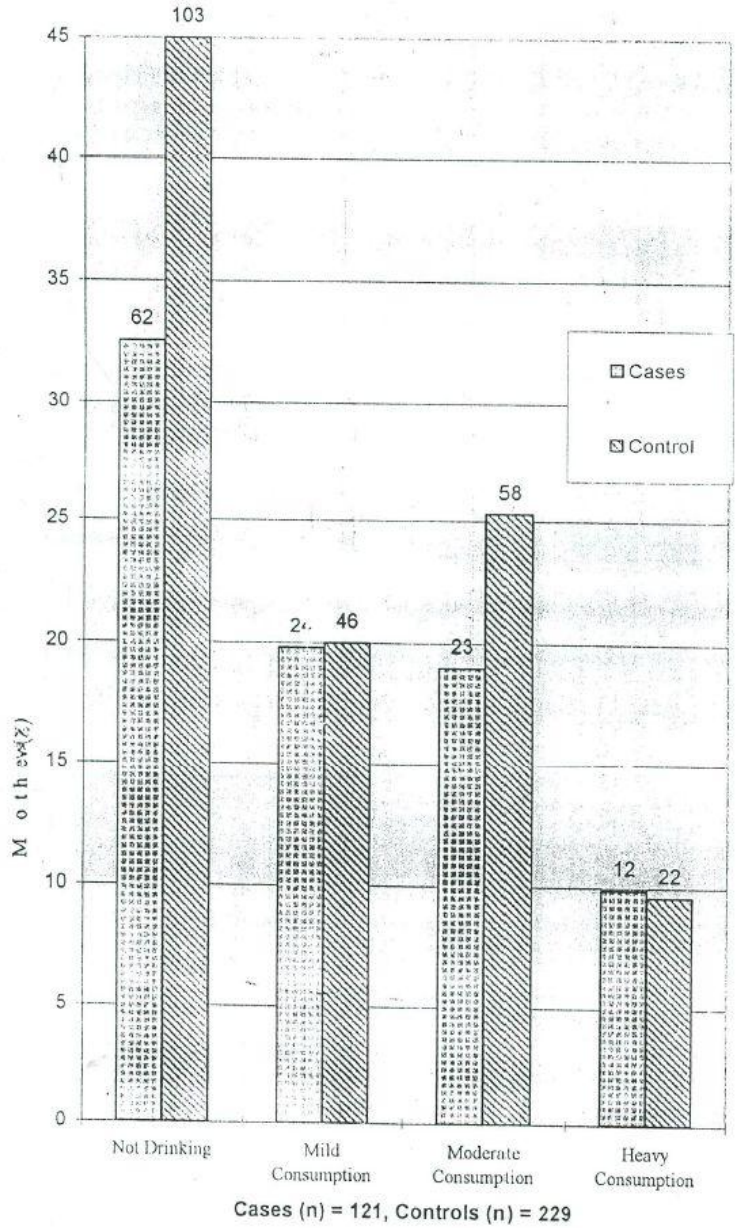
Table 4: Tobacco use (raw tobacco and smoking)

		Cases n = 121(%)	Controls n=229(%)	OR	CI	p-value
Raw tobacco	Yes	12(9.9)	10(4.4)	2.4	1.5-6.0	0.04
	No	109(90.1)	219(95.6)			
Spouse smoking	Yes	38(31.4)	63(27.5)	1.2	0.5-1.39	0.5
	No	83(68.6)	166(72.5)			

Figure 2 shows the degree of local brew consumption by mothers; 185 (53%) of all mothers were consuming an average of 5 litres of local brew (Mbege) in a week. Twelve (9.9%) of the cases and 22 (9.6%) of the controls were consuming an average of 10-15 litres a week. Twenty three (19.0%) of the cases and 58 (25.3%) of the controls were moderate consumers taking an average of 5-10 litres a week. Twenty four (19.8%) of the cases, and 46 (20.0%) of the controls were mild consumers taking an average of 1-5 litres a week. However, the difference in alcohol consumption between cases and

controls was not statistically significant. In a separate analysis, maternal alcohol consumption during pregnancy did not seem to influence birth weight (p = 0.55).

Fig. 2 **Beer Consumption**



4.3 Cultural factors

Table 5 shows the frequency of female genital mutilation among cases and controls. One hundred and fifty six (44.6%) of all mothers in the study had undergone female genital mutilation in the form of circumcision. Of these, 51 (42.1% were cases and 105 (45.9%) were controls. However, there was no significant statistical difference observed between the two groups (p = 0.5). In a separate analysis, circumcision was significantly associated with prolonged labour (p = 0.04).

Table 5: Frequency of female genital mutilation

	Yes	No	Total
Cases	51(42.1%)	70 (57.9%)	121
Controls	105(45.9%)	124(54.1%)	229
Total	156 (44.6%)	194 (55.4%)	350

OR = 0.86, CI = 0.54 - 1.38, p = 0.5

Table 6 shows the commonest reason given by mothers for undergoing circumcision. The most common reason in 135 (86.5%) of both cases and controls was traditional belief or custom.

Table 6: Reason for circumcision

Reason for circumcision	Cases	Controls	Total
	n = 51(%)	n = 105(%)	n = 156(%)
Traditional belief or habit	46(90.2)	89(84.8)	135(86.5)
Peer group pressure	2(3.9)	7(6.7)	9(5.8)
Parental pressure	3(5.9)	9(8.5)	12(7.7)

Use of local herbs.

Three cases and one control were found to have used local herbs and the only reason mentioned was to augment labour. However, the frequency was too small for any valid comparison

4.4 Maternal factors

Table 7 shows the relationship between parity and perinatal outcome. Forty four (36%) of the cases and 69 (30.1%) of the controls were primigravidae, whereas 33 (27.3%) of the cases and 71 (31.0%) of the controls were para 4 or more. However, the difference in parity distribution between cases and controls was not statistically significant (p = 0.48).

Table 7: Distribution of parity

Parity	Cases	Controls	Total
	n =121(%)	n =229(%)	n=350(%)
1	44(36.4)	69(30.1)	113(32.3)
2 - 3	44(36.4)	89(38.9)	133(38.0)
>4	33(27.3)	71(31.0)	104(29.7)

$\chi^2 = 1.45$, p = 0.48

Child spacing

Spacing of one to two years between the index outcome and the previous one was found in 50 (56.2%) out of 89 cases and 106 (62.2%) out of 169 controls. However, the difference in spacing between cases and controls was not statistically significant (p = 0.57).

Table 8 shows the frequency of feeding during pregnancy. Meals in this context means breakfast, lunch or supper. Thirty nine (32.2%) of the cases and 35 (24.0%) of the controls were taking two meals or less a day. However, the difference in frequency of feeding between cases and controls was not statistically significant (p = 0.12).

Table 8: Average number of meals taken by mothers during pregnancy

No. of meals	Cases	Controls	Total
	n =121(%)	n =229(%)	n = 350(%)
≤ 2	39(32.2)	35(24.0)	94(26.9)
≥ 3	82(67.8)	174(76.0)	256(73.1)

OR = 1.50, CI = 0.89 - 2.53, p = 0.12

Table 9 shows the relationship between severity of physical activity and perinatal outcome. Most mothers, 89 (81.8%) of the cases and 143 (62.4%) of the controls, had extreme and severe exertion during pregnancy. While moderate exertion was associated with a good perinatal outcome (OR=0.22 p=0.000), severe and extreme exertion were associated with more than twice increased risk for perinatal mortality (OR=2.2 and 2.65, p= 0.001 and 0.012). One mother had a sedentary life because she was on complete bed rest due to placenta previae, and three other mothers were advised to do light duties because of threatened abortion.

Table 9: Activity grading during pregnancy

Activity	Cases n = 121(%)	Controls n = 229(%)	OR	CI	P value
Sedentary life or mild exertion	3(2.5)	4(1.7)	1.43	0.31-6.50	0.64
Moderate exertion	15(12.4)	90(39.3)	0.22	0.12-0.40	0.0000
Severe exertion	87(71.9)	123(53.7)	2.2	1.37-3/54	0.001
Extreme exertion	16(13.2)	12(5.2)	2.65	1.26-6.03	0.012

Table 10 shows the frequency of bad obstetric history among cases and controls. The frequency of bad obstetric history was more in the cases than in the controls. Thirteen (10.74%) of the cases had previous history of abortion as compared to 17(7.4%) of the controls. Previous history of perinatal loss was significantly more common in the cases than in the controls (P=0.0006).

Table 10: Previous obstetric loss

		Cases n = 121(%)	Controls n = 229(%)	OR	CI	Pvalue
Abortions	Yes	13(10.74)	17(7.4)	1.5	0.70-3.20	0.4
	No	108(89.26)	212 (92.6)			
Previous perinatal death	Yes	14(11.6)	3(1.3)	9.85	2.8-35.03	0.0006
	No	107(88.4)	226(98.7)			

Table 11 shows the effect of duration of labour on foetal outcome. The duration of labour was longer in mothers who had lost their children. Fifty eighty (47.9%) of the cases had prolonged labour as compared to 30 (30.6%) of the controls. Prolonged labour was associated with twice the risk of perinatal mortality when compared with normal labour (0R 2 p= 0.0019).

Table 11: Duration of labour

Duration	Cases n = 121(%)	Control n = 229(%)	Total
Prolonged labour (< 8 hrs)	58(47.9)	70(30.6)	128(36.6)
Normal duration (> 8 hrs)	63(52.5)	159(69.4)	222(63.4)

OR =2 CI=1.33-3.29 p = 0.00019

Table 12&13 Shows booking status and gestational age at booking of mothers of the cases and controls. Nine (7.4%) of the cases and 2 (0.87%) of the controls did not book for antenatal services at all. Booking in the first trimester was associated with good perinatal outcome (OR=0.6 p=0.04). However, booking in the third trimester was associated with an increase risk of more than three times of the perinatal mortality (OR=3.85, p=0.0001).

Table 12: Booking status

Booking	Cases n=121(%)	Controls n=229(%)	Total n=350(%)
No	9 (7.4)	2 (0.87)	11 (3.1)
Yes	112 (92.6)	227 (99.13)	339 (96.9)

OR 9.12 CI=1.94-42.92 P value=0.0025

Table 13. Gestational age at booking.

	Cases n = 112(%)	Control n = 227(%)	OR	CI	P value
1st trimester	30 (26.8)	86 (37.9)	0.6	0.36-0.9	0.04
2nd trimester	58 (51.8)	126 (55.5)	0.86	0.55-1.36	0.52
3rd trimester	24 (21.4)	15 (6.6)	3.85	1.93-7.70	0.0001

4.5: Medical, antenatal and delivery services

Table 14 shows the walking distance in hours from the households to the nearest health units. In 49 (40.5%) of the cases and 115(50.2%) of the controls, the health units were located at less than half an hour's walking distance. The units were located at two to three hours walking distance in only 7(5.8%) of the cases and 8(3.5%) of the controls.

Table 14: Distance to the nearest Health Units

Distance (In min/ hrs of walking)	Cases n=121(%)	Controls n=229(%)	Total n=350(%)
Less than 30 min	49(40.5)	115(50.2)	164(46.0)
30 min-1hr	59(48.8)	88(38.4)	147(42.0)
1-2hrs	6(5.0)	18(7.9)	24(14.7)
2-3hrs	7(5.8)	8(3.5)	15(4.3)

Table 15 shows the effect of antenatal services on foetal outcome. Seventeen (15.2%) of the cases and 4 (1.7%) of the controls were not examined at all in their first and second visit and for those who were examined, it was mainly abdominal examination and weight which were done. Mothers who were not examined were almost ten times at a risk of encountering perinatal death when compared with those who had all the four

basic examinations done (OR=9.97, p=0.0004). Only 76 (21.5%) of all mothers had all four basic examinations, (abdominal examination, BP, weight and height) done. Examination for pallor and oedema was not done on any of the mothers. In the first two visits, 27 (24.1%) of cases and 24 (10.5%) of controls were not given the routine medications which included tetanus toxoid, ferrous sulphate, folic acid and weekly chloroquine. Mothers who received no medications at all had more than twice the risk for perinatal mortality compared to those who received all the four medications (OR=2.68,p=0.002). In general, 62 (55.4%) of the cases and 125 (55.1%) of the controls received only one medication, mostly T.T. Two cases were reported to have been given valium.

Only 67 (18.7%) of all mothers were investigated during their visits in the antenatal clinics. Haemoglobin estimation was done in only 43 (12.3%) of mothers attending antenatal services. Other blood investigations like VDRL and blood grouping were not done in any of the mothers

Table 15: Antenatal services

	Cases n = 112(%)	Control n = 227(%)	OR	CI	p-value
Examination					
No examination	17(15.0)	4(1.7)	9.97	3.27-30.73	0.0004
Only Abd. examination	22(19.8)	51(22.3)	1.78	1.10-2.91	0.02
Abd Exam.&Wt/ BP &Wt	56(50.0)	124(54.2)	1.26	0.53-1.31	0.48
Abd, BP, Wt, & Ht.	17(15.2)	48(21.8)	0.66	0.36-1.22	0.24
Medications(T.T, Ferrous sulphate, folic acid and weekly CQ.)					
None	27(24.1)	24(10.5)	2.68	1.47-4.1	0.002
Single medication	62(55.4)	125(55.1)	1.01	0.64-1.60	0.50
Two medications	21(18.8)	71(31.3)	1.01	0.57-1.87	0.5
All three medications	2(1.8)	7(3.1)	0.8	0.57-0.12	0.7
Investigations					
None	89(79.5)	150(66.0)	1.98	1.16-3.39	0.01
Blood investigation (Hb)	16(14.25)	26(11.8)	1.3	0.66-2.51	0.48
Blood & Urine or Stool	7(6.25)	49(21.3)	0.8	0.34-2.11	0.8
Blood, Urine & Stool	0(0.0)	2(0.9)			

Table 16 shows the most common place for delivery, the competence of the attending person and mode of delivery and their relationship with perinatal outcome. Most mothers, 291 (83.1%), delivered at the health units but significantly more cases 31(25.6%) than controls 28(12.2%) delivered at home or on the way to the health unit (P=0.002). Two mothers unexpectedly delivered while working in their farms

Twenty seven (21.7%) of the cases as compared to 26 (11.4%) of the controls were delivered by their relatives, or delivered without help, while a few were delivered by traditional birth attendants (p = 0.01). Surgical intervention of the delivery was done in 12(9.9%) of the cases as compared to 5 (2.2%) of the controls (p = 0.002). Three had assisted breech delivery, 6 had caesarean section, 2 vacuum extraction and one had destructive surgery after IUFD.

Table 16: Delivery services

	Cases n = 121(%)	Controls n = 229(%)	Total n = 350(%)	p-value
Place				
Health Unit	90(74.4)	201(87.8)	291(83.1)	
Home or others	31(25.6)	28(12.2)	59(16.9)	0.002
Attendants				
Trained	94(78.3)	203(88.6)	297(84.9)	
Non-trained and others	27(21.7)	26(11.4)	53(15.1)	0.01
Mode of delivery				
SVD	109(90.1)	224(97.8)	333(5.1)	
Surgical intervention	12(9.9)	5(2.2)	17(4.9)	0.002

4.6: Foetal factors

Birth weight

Table 17 shows the distribution of the birth weight. About 282 (80%) of the babies were of medium size (birth weight 2500 - 3500 gms). A significant number of cases 34(28.1%) and that of the controls 7(3.1%) had low birth weight or were small (birth weight >2500gms). Only 27 (7.7%) of all the babies had birth weight above 3500 gms (P = 0.000).

Table 17: Birth weight

Size	Cases n = 121(%)	Controls n = 229(%)	Total n = 350(%)
Small	34(28.1)	7(3.1)	41(11.7)
Medium	78(64.5)	204(89.1)	282(80.6)
Large	9 (7.4)	18 (7.9)	27(7.7)

$\chi^2 = 48$, p = 0.0000

Table 18. Gestational age at birth.

Table 18 shows the distribution of gestational age at birth of the cases and control. Significantly more cases than controls were delivered preterm. Fifteen (12.4%) of the cases and 2 (0.9%) of the controls were delivered at a gestational age of seven months, while 20 (16.5%) of the cases and 2 (0.9%) of the controls were delivered at a gestational age of eight months (P = 0.000)

Table 18: Gestational age at birth

	Cases	Controls	Total
	n = 121(%)	n = 229(%)	n=350(%)
7 months	15(12.4)	2(0.9)	17 (4.9)
8 months	20(16.5)	2(0.9)	22(6.3)
9 months	86(71.1)	225(98.2)	311(88.9)

χ^2 =59.09, p = 0.000

Condition of the baby at birth and neonatal care

Most of the cases, 76(58.7%), had delayed first cry (crying after 10 minutes). Delayed crying ranged from 10 minutes to 3 hours with an average of 40 minutes. Ten (17.4%) of the cases with delayed cry never cried. Mothers who did not remember the condition of their baby on delivery were under the influence of anaesthesia. Of the babies who were resuscitated, 97% had basic resuscitation which included wiping, upside down positioning and suction by a syringe or suction machine. Three cases were given oxygen by nasal catheter , and external cardiac massage was done in 2 of them. Most babies, 311(88.9%), were kept warm by wrapping them with a piece of clothing material (khanga) and placed near their mothers. However, none had maternal body contact. One case which was severely premature was put in a neonatal incubator and another one was put under the electric bulb.

Breastfeeding was delayed in 25 (21.6%) of the cases. The delay ranged from 4 hrs to 3 days. The mean delay was 20 hrs ($p = 0.000$). Delay in breastfeeding was due to prematurity in 32% of the cases. The condition of the baby i.e. delayed crying, distress, difficult in breathing and weakness were the main causes for delay in breastfeeding in the rest of the 15 cases. Maternal reasons like weakness after delivery, mother taking a bath or maternal sickness were some of the causes for the delay in breast feeding among the controls .

Prelacteal feeds and reason

Prelacteal feeds were given to 16 babies, six (4.9%) of whom were cases and 10 (4.36%) controls. The most common prelacteal feed was plain water in seven babies followed by glucose solution in three babies, herbs in three babies, black tea in two and cows-milk in one baby.

Inability of the baby to breastfeed, because of either being sick, asleep, premature or crying excessively were the main reasons for giving prelacteal feeds in 11 (66.7%) out of 16 babies. Maternal inability to express milk, abdominal pain or not taken a bath were the main maternal reasons for giving prelacteal feeds in 5 (33.3%).

Congenital Malformations

There were 6 babies who were born with congenital anomalies. Three had bilateral clubfoot, two (one of whom died during the perinatal period) had cleft palate, and one had omphalocoele and died two days after delivery.

Causes of perinatal deaths

Figure 3 and 4 shows the causes and perinatal age when death occurred. Majority of the deaths, 66(55%), were fresh stillbirths due to obstetric problems. Twenty five (19%) were early postnatal deaths occurring within 3 days, showing that they were partially due to prolonged labour insults. Most of the late postnatal deaths (4-7 days) were mainly due to infections. According to the verbal autopsy report, two babies died of meningitis, 4 died of septicaemia, 4 of pneumonia and 3 babies were premature and died of hypothermia. The most common cause of death for the 23 macerated stillbirths was maternal diseases mainly malaria which accounted for 15 (65.2%) of the reported deaths. Other causes were pre-eclampsia in four cases and anaemia in one case. The cause for macerated still births could not be identified in three cases. Some of the perinatal causes of death were antepartum haemorrhage, pregnancy induced hypertension and malpresentation. In 16 (13%) of all cases, the cause of death could not be identified by verbal autopsy.

Fig.3 **Perinatal age at which death occurred**

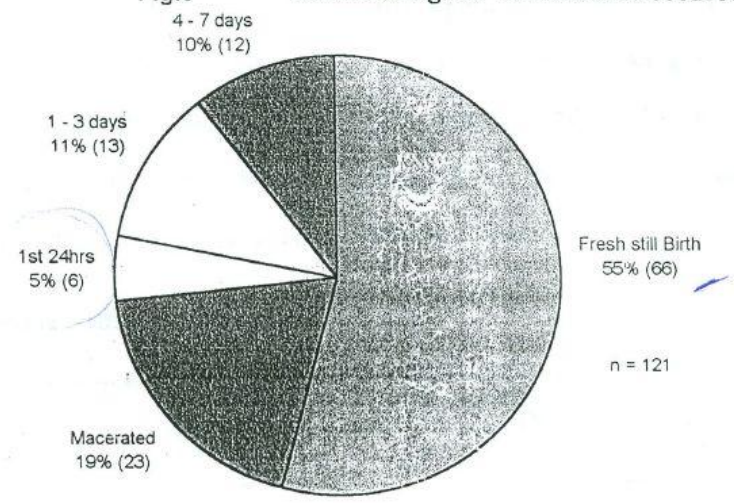


Fig.4 **Causes of perinatal death**

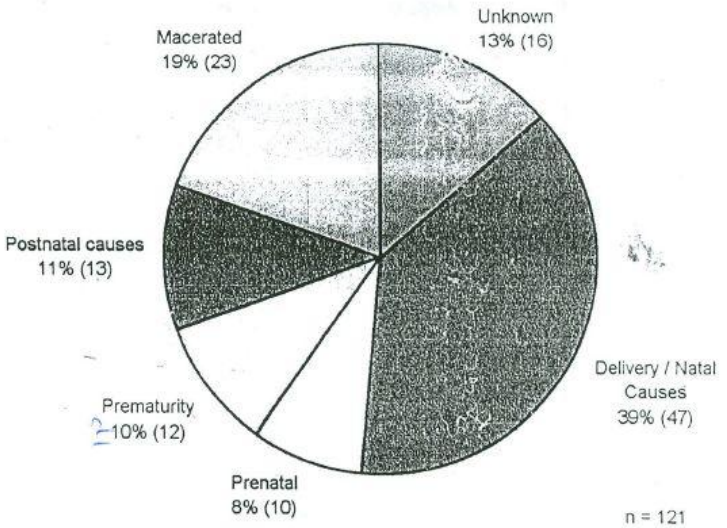


Table 19 shows the result of multiple logistic regression. In the final model the following factors were found to be the predictors for perinatal mortality: being attended by untrained personnel, not booking for antenatal services, booking in the third trimester, delayed surgical intervention of delivery, prolonged labour, low birth weight, severe physical exertion, previous history of perinatal loss, not being examined or not receiving routine medication during antenatal visits and home delivery..

Table 19: Estimates of coefficients of the predictive variables.

Variable	[1]β	[2]SE	[3]DF	P-value
Attendant non-trained	0.4535	0.1606	1	0.0047
Raw tobacco use	0.5088	0.3362	1	0.1302
Not booking	1.9878	0.8162	1	0.049
Booking 3rd trimester	3.327	1.0732	1	0.0019
Surgical delivery	0.3856	0.1221	1	0.0017
Prolonged labour	0.7575	0.2863	1	0.0082
Low birth weight	-1.5736	0.4511	1	0.0005
Severe exertion	0.7036	0.3137	1	0.049
Previous perinatal loss	0.6126	0.5018	1	0.0205
Not examined	-0.6888	02761	1	0.0126
No medication	-0.3884	0.1740	1	0.0242
Not investigated	-0.4507	0.2331	1	0.5310
Delivery at home	0.4507	0.2852	1	0.0001
Constant	1.0226	0.4070	1	0.0012

[1]β = Correlation coefficient. [2]SE = Standard error of β. [3]DF = Degrees of freedom.

5. DISCUSSION

Several risk factors have been found to be associated with perinatal mortality. They include: socio-demographic, socio-economic, environmental, maternal and foetal factors, and provision of medical, antenatal, delivery and neonatal care.

The characteristics of the population in this study were similar. The mean maternal age was 27 years in both cases and controls. Mothers of 11.5% of the cases and 7.9% of the controls were teenagers, aged ≤19 years, while 19.2% of the cases and 16.2% of the controls were more than 34 years of age. However, the difference in age between mothers of the cases and those of controls was not statistically significant, meaning that it was not a risk for perinatal mortality. In a similar community based study by Greenwood et al[18] in Jamaica, the mean maternal age was 24 years for cases and 25 years for controls. The frequency of teenage pregnancy in this study was 9% among the cases and 7.4% among the controls, and the result did not influence perinatal outcome. In a hospital based study by Tan[10] , teenage mothers had three times increased risk for perinatal mortality, while mothers aged more than 34 years had twice increased risk for perinatal mortality. In comparison to community based studies, hospital based studies deals with a selected group of referred high risk patients, and so the frequency of high risk groups such as teenagers and mothers with advanced age is expected to be higher in hospital than community based studies.

Teenage pregnancies are usually associated with poor antenatal care, increased risk for prolonged labour, foetal distress, postpartum complication like haemorrhage and poor neonatal care. Advanced age pregnancies have also increased risk for congenital anomalies and labour complication, and so they should both strictly be regarded as high risk pregnancies.

The mean maternal height was 154 cm for mothers of cases and 156 cm for mothers of controls. The difference in maternal height in this study was not found to be a risk for perinatal mortality. The average height for both cases and controls is above the critical height of 150 cm. It has been observed that mothers who are less than 150cm tall have higher chances of developing prolonged and obstructed labour with consequent poor perinatal outcome[8].

Married mothers formed 82% and single mother 18% of the study population. However, marital status was not found to be a risk for perinatal mortality. This contrast with studies by many other authors which show that single mothers are at an increased risk of perinatal mortality[5,8,22,21]. Mension et al[64], while studying perinatal outcome in a black South African population, found out that the risk for poor perinatal outcome was three times higher in single mothers. Single mother are likely not to utilise antenatal services properly, and they are also likely to show up late in pregnancy, sometimes in established labour. Most single mothers are also likely to be teenagers. All these increase the risk for perinatal loss.

The literacy rate in this study was 96.7% among cases and 98.7% among the controls. Most of the mothers (93%), had attained primary education. However only 7% of the study population had gone beyond primary education. Because of very low frequency of post primary education in this study, it is difficult to make a valid conclusion on the role of the level of education on perinatal mortality. While in Kibaha and Kisarawe[57] post elementary education did not influence perinatal outcome, Victoria et al, in Brazil[65] found that post elementary education was associated with less parity, decreased prevalence of low birth weight, and better foetal and maternal care.

The socio-economic status of the families in this study were comparatively better than in most places[6]. This explains why it did not form a risk for perinatal mortality. Indicators of better family socio-economic status were good housing with reliable

roofing, availability of electricity, reliable water sources, presence of sheltered toilets, dairy cattle farming and good land use for farming. Many other studies done elsewhere in the developing countries show that poor family socio-economic status has been associated with poor perinatal outcome [18,35,57]. Family socio-economic status is likely to be associated with poor antenatal health, poor medical and antenatal service utilisation, maternal malnutrition, LBW and poor neonatal care.

Less than 3.5% of mothers and their spouses in this study were employed. This is expected because the study was done in a rural area where the majority of people are peasants. Due to low frequency of employment, the role of employment on perinatal outcome could not be analysed. Greenwood et al, in Jamaica[18] ,found that employment of any of the parents was protective against poor perinatal outcome.

Goitre as an indicator for iodine deficiency, was found only in three cases and one control. The frequency of goitre was too low for a valid comparison. However, the study was done after delivery and so did not represent the true goitre status during pregnancy. Iodine deficiency has been associated with intrauterine foetal deaths, low birth weight and early neonatal deaths due to hypothermia[36].

About 60% of all the deaths occurred during the cold and rainy season of the year, which stretches from April to August. July which is the coldest month of the year had the largest number of deaths compared to other months. Hypothermia is considered to be contributing factor, and elsewhere is said to be one of the most important causes of perinatal mortality. Shah[38] found hypothermia to be the most important cause of death in babies who are delivered outside hospital setting. Drying of babies immediately after birth, covering them with at least three layers of clothing and direct maternal warmth are necessary measures in reducing the incidence of neonatal hypothermia. In the present study, about 90% of babies were reported not to have been dried at delivery. Moreover, babies were covered with only one or two layers of thin cloth material (khanga) which

was sometimes wet, while most mothers took a bath immediately after delivery. The above practices support the assumption that neonatal hypothermia was the most likely cause of increased perinatal mortality during the cold months of the year.

There was no maternal smoking observed in this study, but 30% of spouses were found to be smoking. The rate and amount of smoking was similar between cases and controls, and did not seem to influence perinatal outcome. Most studies which are done determine the effect of smoking on the baby and perinatal mortality are mainly based on maternal smoking [33]. It is however currently accepted that paternal smoking is as bad as maternal smoking and has the same effect[26]. In industrialised countries, maternal smoking is a major problem where it accounts significantly to low birth weight. There are few known studies on the effect of passive smoking on perinatal outcome, most studies done are based on maternal smoking. The 42% frequency of maternal smoking seen by Raiha et al[33] was significantly associated with perinatal mortality. The 30% frequency of smoking observed in this study was not associated with perinatal mortality. It is possible that the exposure was not adequate for comparison. The use of raw tobacco for sniffing or chewing was observed in 9.9% of the cases as compared to 4.4% of the controls (P = 0.04). However, the frequency is too low for any valid conclusion to be made.

The frequency of use of local brew was 48.7% among the cases and 55.0% among the controls. The amount and frequency of drinking was not significantly different between cases and controls. The average intake was 5 litres a week. In 9.9% of the cases and 9.6% of the controls the average intake of local brew was 10-15 litres a week. Most studies done on maternal alcohol use have been based on beer with known amounts of alcohol content.[32] In this study, the amounts of alcohol in the local brew is unknown and obviously variable, thus, making it difficult to comment on its effect on the perinatal outcome.

The frequency of use of local herbs in this study is very low for any valid comparison to be made. Only four mothers had used it for the purpose of augmenting labour, three of whom had perinatal deaths with one associated maternal death. The use of local herbs is known to be associated with increased incidence of ruptured uterus, foetal distress and postpartum haemorrhage.[16,4,2]

Female genital mutilation in the form of circumcision was done in 44.6% of all mothers in the study. The most common reason for the procedure was traditional belief, few were due to peer group (Sangoma) and parental pressure. However, genital mutilation was not significantly associated with perinatal mortality. In three cases, the procedure was done when they were under five years of age and in the rest it was done during adolescence. There were also few cited health units where the procedure was done by health workers and these were the places preferred by girls because of less mutilation and occasional use of local anaesthesia.

There were six maternal deaths in this study, five of which were accompanied with perinatal deaths. The frequency of maternal deaths was too small for a valid comparison. Whenever there is maternal death there is almost always associated perinatal death[8].

Too many pregnancies have been associated with an increased risk for perinatal mortality[19]. In this study, 36.4% of the mothers of cases and 30% of the controls were primigravidae and 27.75% of cases and 31.5% of controls had parity of four or more. However, the difference in parity between the cases and the control was not statistically significant. Therefore, parity was not a risk factor for perinatal mortality. Fakeye[14], in his hospital based study, found a two times increase in the risk for perinatal mortality in primigravidae, and a three fold increase with parity of more than three. Primigravidae and multiparae are likely to deliver in hospitals and so their proportion in the hospital

based data would be expected to be higher than in the community based data, like the present one.

Spacing between the index outcome and the preceding one was less than 3 years in 56.2% of the cases and 62.2% of the controls. However, the difference was not statistically significant and did not form a risk factor for perinatal mortality.

Too close pregnancies in the families with poor socio-economic status are more likely to be associated with increased risk for perinatal mortality than in the families with good socio-economic status. Comparatively better socio-economic conditions in this present study have most likely outweighed the effect of closely spaced pregnancies. Again, this is in sharp contrast with other studies which found less than 3 year of spacing to be associated with increased perinatal mortality[14]. Various other studies have also shown that spacing of about 3 years carries best maternal and foetal outcome[3,22,42].

Thirty two percent of the mothers of cases and 24.0% of the mothers of controls were taking less than 3 meals a day. The difference in frequency of feeding between cases and controls was not statistically significant. Meals in this context mainly meant, breakfast, lunch and supper and any other additional meals or snacks. However, most mothers were taking just a cup of plain tea or porridge in the morning and this did not represent a true meal for breakfast.

Frequency of feeding was also influenced by physical activities. Most mothers were overwhelmed with family activities thus remaining with little time to prepare their meals. Nutritional status of the mothers before and during pregnancy, nutritional demands of repeated pregnancies and the diet during pregnancy all affect foetal growth[8,31].

Mothers who had experienced moderate and severe physical exertion during pregnancy had more than twice increased risk of perinatal mortality. Physical over-exertion during pregnancy has been associated with poor weight gain and LBW.[19]

Premature deliveries are more common in mothers who are over-worked during pregnancy.[8]

History of prolonged labour was present in 47.9% of the cases as compared to 30.67% of the controls and this was strongly associated with perinatal mortality. These findings are in agreement with most of the studies done to determine relationship between the duration of labour and perinatal outcome[15,18,24]. Prolonged labour is associated with foetal distress, birth asphyxia and respiratory distress.

Utilisation of antenatal services was poor in this study, whereby. Eleven of all the mothers did not book at all and 9 of them had perinatal deaths. The frequency of booking was 95% in both cases and controls, but this was inefficient because almost 60% booked in the late second or third trimester. Booking in the third trimester was associated with a two fold increase of the risk for perinatal death.

During the visits, 15.2% of the cases and 1.7% of the controls were not examined at all. Blood pressure was examined in only 14.4% of the cases and 18.8% of controls. Furthermore, very few mothers were investigated. About 80% of both cases and controls were not investigated at all during their antenatal visits. None of the basic investigations (blood grouping, haemoglobin estimation, routine urine and stool examination) were done in any of the cases, and they were done in only two of the controls. All the four important medications which included chloroquine for malaria prophylaxis, ferrous sulphate, folic acid and tetanus toxoid were given to only 2(1.8%) of cases and 7(3.08%) of controls. Otherwise, 24% of the cases and 10.5% of the controls received no medication at all. The rest, 84.2% of the cases and 73.5% of the controls, received one or two of the recommended medications.

Antenatal care provides health education and identifies high risk pregnancies. It also provides health education for the care of the neonate. Therefore, mothers who do not book or those who book late are less likely to benefit from antenatal care. Similar

observations were found by Blondal et al[25]. He compared mothers with less than 3 visits as poor attendees and those with more than 3 visits as good attendees and found out that poor attendees had a five fold increased risk of perinatal mortality and four fold increased risk of premature delivery. Attendance to the antenatal clinic is not all sufficient if the services are poor as in this study. Identification and management of high risk pregnancies through thorough examination, investigation and provision of basic prophylaxis for malaria, anaemia and neonatal tetanus is very important.

Despite health units in this study being at an hour's walking distance to the majority of the users, 25.6% of the cases and 12.2% of the controls delivered at home or on the way to the health unit. Two others in the control group delivered precipitously while working in their farms.

Home deliveries are likely to be attended by relatives and occasionally by TBAs. In the present study significantly more cases 21.7% as compared to 11.4% of controls were delivered by personnel with no formal training. The current results are in conformity with those by Walvaren et al[41] in Mwanza, Tanzania who found a three fold increase in perinatal mortality in home births. Even in developed countries like Germany, home deliveries are associated with a three fold increase in perinatal mortality[66].

Delivery by caesarean section, assisted breech, instrumental deliveries and vacuum extraction was associated with increased perinatal mortality rate (P = 0.002). The results are in contrast to findings by Shehata et al[28] in Saudi Arabia, who showed that an increase of caesarean section rate from 4.4% to 6.0% could decrease perinatal mortality from 26 to 16 per 1000 total births. Poor referral system resulting into delayed intervention in our circumstances could explain the unexpected increased risk of foetal deaths in surgically delivered babies.

In this study 28% of the perinatal deaths were small, weighing less than 25000 grams as compared to 3.2% of the controls. The frequency of prematurity was 40%

among the cases and 1.8% among the controls, indicating that prematurity has a strong influence on perinatal outcome. Most foetal and maternal factors that cause perinatal death, initially act through causing LBW. LBW is associated with neonatal hypoglycaemia, low Apgar score, foetal distress, respiratory distress and meconium aspiration[19].

Prelacteal feeds were given to 5% of the babies. The most common prelacteal feed was plain water followed by glucose solution, black tea and herbs. Excessive crying of the babies and inability of the mothers to express breast milk were the commonest reasons for giving prelacteal feeds. In other similar studies, the most common prelacteal feeds were also plain water followed by honey water[67]. Although the practice of giving prelacteal feeds in this study did not influence perinatal mortality, it is however not recommended to give such feeds because they can be detrimental. Babies on prelacteal feeds are at an increased danger of getting neonatal septicaemia and meningitis.

Majority of the deaths, (50%) were fresh still births which occurred during intrapartum period, while 19% were macerated still births. Postnataly, 5% of the deaths occurred during the first 24 hours which still reflects late deaths due to intrapartum insults. Another 11% of the deaths occurred in the first three days, and the remaining 10% between the 4th and 7th day.

Verbal autopsy was used in this study to try and determine the most probable causes of death. The cause of death in the majority of cases (39%) were due to delivery problems such as obstructed labour, foetal distress, delayed second twin delivery and foetal deaths accompanied with maternal deaths. Malaria was mentioned as one of the commonest cause for the macerated births, but despite all the efforts made, it was not possible to know the cause of death for most of the macerated still births. Prenatal causes such as pre-eclampsia, antepartum haemorrhage, and malpresentation were seen in 8% of them. Prematurity was the cause of death in 10% of the babies. Postnatal

causes such as septicaemia, pneumonia, meningitis, hypothermia, and congenital anomalies were the cause of death in 11% of babies. In 13% of deaths the cause could not be established, partly because of inadequate history from respondents other than the biological mothers.

The pattern of deaths is similar to most of the other community based studies.[18,47] However, the frequency of intrapartum deaths in most hospital based studies is higher than observed in the community studies. Walvaren et al[41] observed a frequency of 54% in a community survey and 68% in a hospital based study.

In developing countries where a significant number of deaths still occur at home, verbal autopsy is of particular importance in establishing the cause of death. In principle, verbal autopsy assumes that each disease category has a distinct pattern of symptoms and signs and if reported accurately by a respondent even if they do not interpret within the standard of classification, can lead to a reasonable cause of death[54]. Several authors have tried to validate the used of verbal autopsy[50,52,53,56]. However, the use of verbal autopsy is limited in case of macerated still births, where the cause of foetal death is difficult to establish from the history only.

6. CONCLUSIONS

1. Socio-demographic characteristics are similar in both mothers who had perinatal deaths and those who did not.
2. The socio-economic status of most families was average or above average and there was no significant association with perinatal mortality.
3. Most of the deaths occurred during the cold rainy season and provision of warmth was not adequate.
4. Severe physical exertion and frequency of less than 3 meals a day were associated with poor perinatal outcome.
5. The duration of labour was longer in those who had perinatal deaths.
6. Utilisation of antenatal services was poor in mothers who had fatal perinatal outcome.
7. Antenatal services are not adequately provided despite having many health units which are near to their users.
8. Most deaths are fresh still births due to pregnancy and delivery complication followed by macerated still births and premarturity.

7. RECOMMENDATIONS

1. Medical personnel, TBA's and mothers should be educated on the importance of keeping babies warm after delivery, especially during the cold season. Drying of babies immediately after delivery, covering them with heavier clothes and maternal body contact should be encouraged and educated.

2. The quantity of medical services should go hand in hand with the quality. Improved services in our health units and hospitals is crucial specially antenatal and delivery services. Frequent evaluation of MCH activities is recommended in order to improve the quality of service.

3. There is a need for mothers to do less work during pregnancy. This should be done through the spirit of Safe Motherhood Initiative. This means also educating and involving men in undertaking some of the activities. Mothers should be educated on improved nutrition during pregnancy.

4. Role of neonatal hypothyroidism has not been properly and adequately dealt with in this study. It is recommended that a prospective study to follow up pregnant mothers, observe their goitre status and finally do neonatal screening for thyroid hormones to be done.

5. Simple intervention measures like Kangarooing, training of more TBA and providing them with delivery kits are recommended in an attempt to reduce perinatal mortality.

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