PERINATAL AND LATE NEONATAL MORTALITY IN THE MALTESE ISLANDS

A Socio-Biological Study

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by

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ABSTRACT

In the Maltese islands, the annual still-birth rates and neonatal mortality rates are now below 10 per 1000, so it would seem unnecessary for perinatal and neonatal science to define the relation between pregnancy events and the development of newborns. However one must bear light on the recent trends towards childbirth along with the increasing opportunity provided by assisted reproductive technologies which have increased the number of women considering pregnancy at later ages. This case control study aimed to identify social and biological risk factors which may be associated with these mortalities by comparing these deaths to live births occurring at Karin Grech Hospital between 1993 and 1995. The main information source in this study was the data collected progressively from the Maternity Information System. The total study population was 184 perinatal and late neonatal deaths and 368 controls from live birth survivors.

The results of this study show that in Malta advanced maternal age, low birth weight and preterm birth were associated with these deaths as has been established in other countries. The clinico-pathological associations related to these deaths were congenital abnormalities in low and appropriate birthweights, while in very low birthweight conditions originating in the perinatal period were implicated. These associations highlight the importance of considering the setting up of a perinatology unit run by obstetricians and neonatologists in KGH. Future studies could focus on a better understanding of the causes of low birth weight and preterm delivery among a population which is a small and relatively homogenous community.
Declaration

I, the undersigned, declare that this dissertation is my original work and was carried out under the supervision of Dr. Hugo Agius Muscat M.D. M.Sc. (Warwick) L.R.S.M., Director of Health Information within the Health Division of the Government of Malta.

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Chapter 1: Introduction

Birth, the transfer from intrauterine life as a fetus to extrauterine life as a new born infant, represents the most dramatic change of environment in an individual's life. The process of labour and delivery involves mechanical strains and physiological stresses placed upon the fetus. Exposure to the new external surroundings, with its demands of functional independence, requires autonomous coordination of most body functions. The outcome of birth depends on the relationship between the magnitude of these external factors and the ability of the new-born infant to cope with the new environment. The condition of the fetus depends on several factors: Gestational duration, fetal growth and development in each of the trimesters of pregnancy. Most results of early damage during intrauterine life will be detected after birth, increasing the dangers of the neonatal period. The outcome of pregnancy is either a live birth or stillbirth, thus the period around birth, 'the perinatal period' is most critical for the early survival of the individual.

The perinatal period is of interest for several reasons. Firstly, from a national level, as it affects important vital statistics of a country, which in itself reflects the social and economic status of the population. Secondly, it gives insight to hospital practice and the outcome of maternity services. Since the majority of births and perinatal deaths occur at St. Luke's hospital these data reflect, the national vital statistics of the Maltese islands. Thirdly, perinatal data can be useful for the subsequent care and management of the individual during infancy,
childhood and adolescence. Lastly, those data can be useful for studying trends, for analysing and testing hypotheses in epidemiological studies and for the identification of priorities for improvement of perinatal care.

Comparing perinatal statistics in different countries is difficult, because of variations in definitions. A further obstacle to the assessment of available data is the lack of information about medical, social, biological and environmental factors which may contribute to these mortalities. Reduction in mortality rates that have taken place around the globe in recent years have emphasised the concept of 'survival' through the lifespan as opposed to the avoidance of perinatal mortality. However, one must focus attention upon the escalating costs of providing all forms of health care amidst scarce resources. There has been an agreed consensus that outputs of the maternity care system and all other health care systems needs to be evaluated. Further emphasis has been made on having health policies which focus on the delivery of maternity and paediatric care which will accomplish the best possible levels of outcome in a defined population given the level of cost and availability of resources. Stimulated by these concerns, a number of countries through out the world have carried out numerous studies on the social, biological and clino-pathological risk factors associated with perinatal mortality.

In the United Kingdom, Butler and Bonham,1(963) published 'The First Report of the 1958 British Perinatal Mortality Survey' which showed the importance of
socio-economic and biological factors in determining the rate of perinatal mortality.

The World Health Organisation regional office for Europe set up a Perinatal Study Group in 1979 to investigate the possibility of setting up a surveillance unit in each country of the European Region. The summary report on this descriptive epidemiological study was published in 1985 'Having a baby in Europe', which stated that in order to reduce perinatal mortality and morbidity it is essential also to study population subgroups with special needs in terms of their biological, social, behavioural and cultural characteristics.

Similar associations between biological and social characteristics and perinatal mortality have been confirmed in the Maltese population. Looking at hospital obstetric data on the Maltese islands is unique in how it relates to national vital statistics. Although hospital based studies have been carried out, they are a good proxy for population studies, as St. Luke's Hospital accounted for about 90%, of all births and more than 95% of all perinatal deaths since the 1990's. Savona-Ventura and Grech (1985), published an analysis of perinatal deaths occurring in Malta where they studied all perinatal deaths occurring in St. Luke's Hospital between the period of 1979 and 1982. They relate these deaths to biological characteristics of the mother and the type of obstetric services available.
Peinatal and neonatal mortality statistics have also been affected by birth control methods and fertility patterns which are also changing in recent years. Crude birth rates have been falling since the 1950's, bringing with them a fall of these mortalities. In the Maltese islands the fall in crude birth rates have been attributed to several factors, however due to religious, ethical and legal implications there has been little attempt to disentangle the effects of birth control methods on birth rates. This study looks into the perinatal and neonatal deaths occurring in the maternity and paediatric sections of Karin Grech Hospital between 1993 and 1995. This study uses data that are collected prospectively from the Maternity Information System to look into the social and biological risk factors that may be associated with these mortalities so as to provide information that may enable better concentration of health care support towards these outcomes of pregnancy. Although loss of a fetus or newborn through perinatal and neonatal mortality may be low, it is essential to identify possible avoidable factors that contribute to these deaths. A loss of a baby may have serious negative effects on the mother and her family, which may in turn have serious social and psychological implications in subsequent pregnancies and in her life.
Chapter 2: Literature Review

Foreign

Since 1950 to the late 1970's, perinatal and neonatal mortality has received a lot of attention in the media and scientific research in the developed world. Literature published on this topic has been varied, earlier studies have correlated perinatal and neonatal mortality with socio-economic and biological factors of the mother, while more recent research questions the effects of these risk factors as potential causes of these mortalities. However in the last 15 years researchers have diverted their attention on this subject to the developing countries largely because of the decreasing trends in perinatal mortality that has taken place in the developed world.

Maternal mortality rate and perinatal mortality rate make up two important indices of progress in the obstetric services. It has been generally recognized that these two essential statistics together provide a highly reliable standard of a country's achievement and a sound baseline for planning and improvement in maternity services. In most developed countries the decline in perinatal mortality rates and maternal mortality rates have been attributed to sociological and biological improvement. However the decline in perinatal mortality has been much slower, as it is difficult to ascertain the true cause of these deaths, which is often multifactorial. A major attempt to discover some of these causes in Britain was initiated, Butler and Boham (1963) published their results in 'The First Report of the British Perinatal Mortality Survey'. They based their study on a national
sample of births occurring in one week of 1958 along with an additional sample of 7000 perinatal deaths. The first report dealt almost entirely with perinatal deaths. The results in their survey showed that differences still exist to a marked degree between social classes. Conditions of growth in different regions and classes result in a populations of different height distributions. This was also true of behaviour in respect to marriage and pregnancy, the number of children and the distribution and utilisation of maternity resources. Thus they showed that differences in perinatal death rates reflect wide divisions in social and economic conditions and behaviour. Also that perinatal mortality rises with maternal age after thirty years, it is associated with the type of prenatal care received, past obstetric history, intrapartum anoxia and/ or birth trauma.

The second report, 'Perinatal Problems' based on the same national sample was published by Butler and Alberman (1969). This publication brought forward additional information of high risk pregnancies.

Following the success of the two reports published on the British Perinatal Mortality survey in improving neonatal and maternal care, the National Birthday Trust Fund and the Royal College of Obstetricians and Gynaecologists decided to initiate a fresh Survey. The result of another national study of all deliveries which took place during one week in 1970 was reported by Chamberlain et al (1975). The authors reconfirm that social, biological, maternal and fetal factors influence the stillbirth and neonatal mortality rates. On comparing perinatal deaths in 1958
and 1970, the authors show that the reduction of perinatal mortality in 1970 was due to a 39% drop in the stillbirth rate. However early neonatal deaths experienced a much smaller drop of 14%. The authors suggest that with further improvement in the state of the mother before and during delivery and in the first week of life of the baby can improve both perinatal and neonatal mortality rates.

In the United States data on infant mortality have been available since the 1930's. Incompleteness of birth registration persisted as a serious problem and it was not until the 1950's that 98 percent of live births were registered. Shapiro et al (1968) studied the trends of infant, perinatal, maternal and childhood mortality for the period of 1930's to 1960's. They report that during the 1950's and early 1960's the decline in infant mortality rate slowed down appreciably. They postulated several reasons for the slow decline: Changes in racial or geographical composition of births did not explain the slow decline. It was the increase in births in the comparatively high risk group of very young women and women with many pregnancies. On comparing between high risk groups and the more favoured groups, they found that non-white women had twice as high a death rate as white women, especially in the neonatal and post neonatal period. The shift of non-white women to the metropolitan area contributed further to the increase of perinatal mortality in the cities. The risk of perinatal mortality increasing by four to five times in the presence of major obstetric complications in these non-white women.
Studies based on regional or national populations in different countries have shown that teenage pregnancies have resulted in high perinatal risks in terms of mortality, preterm delivery and low birth weight. Since the last 15 years factors influencing fertility have changed considerably, the use of the birth control methods have increased in the developed countries. This has effected fertility rates in women especially in the younger age groups. In view of this Blondel et al (1987) carried out a study over a 10 year period (1972-1981), to compare the pregnancy outcome, social situations and perinatal risk factors among women under 20 years of age with those of women 20 and over. Their results show that preterm delivery among women under 20 remained stable during the 10 year period while it declined significantly among older women. On analysing the data in narrower age groups they found that preterm delivery was significantly higher in primiparas 18 to 19 years of age than among those in the 20 to 29 year age group. However they did not find a correlation between the social characteristics of these teenaged women and preterm delivery due to a lack of data on the description of the behavior and specific difficulties of these women. Olausson, Cnattingius and Goldenberg (1997) undertook a study to assess pregnancy outcomes among teenagers using data from the Swedish Medical Birth Registry. Their results show that girls of 17 years or less were at a higher risk for preterm births, while late fetal deaths and infant mortality was substantially an effect of poorer socioeconomic characteristics of these teenagers. Despite the magnitude of the problem, it is not yet clear whether poorer outcomes of teenage pregnancy are attributed to the biologic factors of young maternal age or solely to the consequences of sociodemographic factors. Although there may be many
controversies about the effect of teenage pregnancy on clinical outcome, there is little doubt about its social impact. Most teenage pregnancies are unintended, many of which end in abortions. These mothers tend to be single, poorly educated and financially poor.

Pregnancy and birth rates among teenagers are higher in the United States than in any other developed country. A study carried out by Elster (1984, Utah) in adolescent mothers indicate that perinatal risks are affected by both physiological factors and late prenatal care of these mothers. He reports that teenage pregnancy is common in all social, economic, and racial groups. However these teenagers are at a reproductive disadvantage as they end in premature births, small for gestational age, are of low birth weight and are prone to perinatal deaths. Fraser et al (1995) investigated whether young maternal age is associated with poor pregnancy outcomes in a study carried out also in Utah. They report that the influence of sociodemographic factors, inadequate prenatal care was associated with poor pregnancy outcomes. However, the risk of teenage mothers having poor pregnancy outcomes remained significantly higher even when the analysis was limited to married mothers with appropriate educational levels and who received adequate prenatal care. This elevated risk suggests that young age in the mother increases the risk of adverse outcomes of pregnancy due to biological immaturity of these mothers and the fact that these girls becoming pregnant before their own growth is complete. Satin et al (1994) also looked into the reasons why teenage women who are young and likely to be in their best lifetime health should be at a disadvantage to the outcome of
pregnancy, carried out a study to measure pregnancy complications in middle school, and high school girls and compare them to older maternal age groups, for the period of 1988 to 1991. Their results show that poor pregnancy outcomes were significantly increased only in middle school mothers (11-15 year olds) High school mothers (16-19 year olds) did not experience pregnancy complications and poor outcomes when compared even to older mothers.

On the other hand many women today postpone childbearing until their careers are well established. Assisted reproductive technologies have augmented substantially the number of women considering pregnancy at advanced maternal age, many for the first time. Fretts and Usher (1997) carried out a study specifically to address the effects of advanced maternal age on the causes of fetal deaths. The results of this study shows that advanced maternal age is no longer associated with an increase risk for fetal death due to congenital anomalies. Older women have a significantly higher risk for unexplained fetal death.

In recent years, the number of extramarital conceptions has shown a marked increase, illegitimacy is changing, both legally and socially. Unmarried women no longer feel the stigma of such births. However it has been known that babies born to unmarried mothers suffer great risks of low birth weight, perinatal and infant mortality. There are several explanations for this: economic deprivation, cultural, social and genetic factors result in the adverse effects of loss of a baby.
However not all unmarried women live alone, it is known that some cohabit with the father or another partner, others still live at home with their parents and the women who live alone may also be living with children under working age. Mac Donald, Peacock and Anderson (1992), examined the association of marital status with socio-economic, psychological factors and with the outcomes of pregnancy in a study population of 1431 white women (U.K). Their results showed that when compared with married women, unmarried women tended to be younger, less educated, of low social class, more dependent on the state for support and more depressed about their situation, all potential factors known to increase the perinatal and infant mortality rate. Peacock, Bland and Anderson (1995), undertook a prospective study to examine the relationship between preterm births and other socio-economic and psychological factors and smoking habits. Their results show that adverse social circumstances are associated with preterm birth but smoking was strongly related to reduced fetal growth only among the women who delivered before 32 weeks. The authors thus showed that the risk factors for the two components of birth weight (fetal growth and gestational age) are different.

Simpson (1957) was first to report on a lowering of birth weight among infants of mothers who smoked during pregnancy. Butler and Alberman (1969), in the second report of the 1958 British Perinatal Mortality survey, showed that birth weight was reduced in the infants of mothers who smoked which consequently resulted in late fetal and neonatal mortality. The authors showed that even after adjusting for all other confounding variables, the difference in birth weight and
perinatal mortality between smokers and non smokers remained. Butler and Goldstein (1972) carried out an analysis using the data gathered from, the British Perinatal Mortality Survey to reconfirm the influence of cigarette smoking in pregnancy. They categorized the smoking mothers into four groups, based on the average number of cigarettes smoked and also considered the effect of change in the number smoked between the beginning of pregnancy and the end of the fourth month. Their results show that in a British population, cigarette smoking during pregnancy increases the risk of late fetal and neonatal mortality by 28 percent and reduces birth weight by 170 grams. Stimulated by these findings Cardozo et al (1982), went on to study the associations between social factors and obstetric performance in smoking women. They analyzed the smoking habits of 2000 consecutive mothers in relation to their race, social factors and their obstetric outcomes. They found that the most significant differences between smokers and non smokers, were the decrease in mean birth weight and the small for gestational age in smokers. However, they failed to show a significant difference in the perinatal mortality among these women.

Although there are many studies that have shown an elevated risk of perinatal mortality among infant of smokers it is not clear whether this increased risk is due to the effect of smoking on birthweight or to an independent effect of smoking. English et al (1992) present a method to standardize for birthweight while adjusting for variable that may confound the relationship between maternal smoking and perinatal mortality. They found that 85 percent of increased mortality due to smoking was attributable to an excess of small births both by size.
and gestation in these mothers, while 15 percent was due to higher birthweight specific mortality at almost all standardized birthweights.

Although researchers have focussed their attention to study perinatal mortality in the less developed countries, there still remains a lack of sufficient literature published. It is well established on comparing these mortalities to other well off nations, that there is a significant difference in these deaths. These between country differences highlight the importance of social and economic factors in the causation of these mortalities, yet there has been a little attempt into investigation to measure the relative risk associated with these factors largely because of the scarcity of data that is made available. Prematurity is a major risk factor for neonatal mortality and morbidity especially in developing countries where health services are limited. Przuck et al (1993) carried out a study in West Africa to assess the environmental and socioeconomic risk factors for preterm delivery. Their findings identify adverse pregnancy outcomes in mothers less than 20 years of age, who are of single marital status, have low frequency of antenatal visits and levels of education. Bobzom and Unuigbe (1996) reviewed the causes of perinatal mortality in the University of Benin Teaching hospital, Nigeria between 1987 and 1989. They found that stillbirths contributed to nearly 50 percent of the perinatal deaths. The perinatal mortality for the unbooked patients was 8 times that of the booked patients. The major causes were intrapartum asphyxia (20.6%), prematurity (19.4%), and abruptio placentae (13.9%). The cause of death was unknown in 19.4% of deaths. They showed that perinatal mortality in Benin in 1989 was about 6 times the average in European countries for 1984 presumably due to socioeconomic factors.
It is widely assumed that women who attend late for antenatal care are at a higher risk of adverse pregnancy outcomes. Measures to encourage earlier attendance have been advocated as a means of reducing perinatal mortality, although there has been few studies carried out on preventive care in early pregnancy. Strachan (1987) used data from Scottish maternity hospital discharge returns and analysed the relationship between gestational age at antenatal booking and perinatal mortality during 1972-1982. His results show that there was a general increase in the proportion of maternities booked before 17 weeks gestation, but no significant difference was found between the standardized perinatal mortality rates for pregnancies booked before and after 17 weeks gestation. However the author does state that perinatal mortality for the given period was high among women with no booking data and single women.

There is an agreed consensus among the obstetricians about the need for providing effective care during pregnancy and childbirth, however there are wide variations in obstetric practice throughout the globe as well as over a period of time. Mascarenhas and Eliot et al (1992) compared national statistics of England and Wales with that of France. Although there were limitations in this comparison (obstetric care in England and Wales is mainly confined to the public sector while in France 47% of the total maternities are in the hands of the private sector). Their results showed that in England and Wales there was more antenatal intervention and marginally less intrapartum intervention as compared with
France. Although both countries differed significantly in their methods of obstetric practices, there was no significant difference in the perinatal mortality rate, in the incidence of low birth weight or preterm delivery, similar trends being observed over the two decades.

Infant and perinatal mortality has fallen steeply in most developed countries. This reduction can partly be explained by socioeconomic and health care development. It could be explained by qualitative and quantitative differences in nutrition or by the observed correlation of socioeconomic factors with adverse life events. However within country differences still remain even in the developed world. Lardelli et al (1993) carried out a study to assess the influences of socioeconomic and health development on infant and perinatal mortality in Spain between 1975 and 1986. The authors attributed the reduction of both these mortalities in the 1975 period to an improvement in mean family income. While in the more recent period of 1986 the economic component was replaced with the improvement in prenatal and neonatal health care. Thus they concluded that there are three stages in the evolution of infant and perinatal mortality that can be highlighted in every country: “(a) an initial relationship with improvement in basic health care which progresses to (b) an association with economic factors, and (c) a return to dependence upon specialized prenatal and neonatal health care.”

High perinatal mortality is commonly seen among ethnic minorities and immigrant populations (Parson & Day 1992). However it is not clear if these differences are
attributable to biological, socioeconomic, behavioral and cultural factors specific to immigrant groups or a combination of these. Lumey and Reijneveld (1995) carried out a matched case-control study in an ethnically mixed population in Amsterdam to assess whether there was an association between biological and social risk factors and perinatal mortality. Their results show that employment status and not the country of birth should be the main focus in studies of perinatal mortality in populations of mixed ethnicity in addition to the well known predictors like age of mother, parity and infant sex.

In spite of the marked improvement in socioeconomic factors and the progress of health care in respect to both quality and accessibility, there is no evidence that preterm births showed any change. Maternal and infant health policies have focussed on the reduction in preterm birth through strategies focusing on a number of combined measures. Adjustment of lifestyles and occupational activities directed at subgroups of individuals who are at an increased risk in order to modify their risk and control the outcome of pregnancy. However the cause of preterm birth is largely unknown, thus the lack of preventive measures to correct these situations. There have been few publications on population based studies on the relation between sociodemographic factors and preterm births, the findings of which are dubious. Fedrick and Anderson (1976) studied these associations based on the 1958 British Perinatal Mortality Survey, their results show that the risk of preterm birth is related to a number of factors such as maternal age, illegitimacy, low social class, low maternal weight, maternal smoking and adverse past obstetric history. But the authors defined preterm birth
as the delivery of a low birthweight infant following spontaneous labour before 37 weeks, thus excluding from their study babies weighing more than 2,500 grams, those macerated fetuses delivered by induction of labor or elective cesarean section and those with a visible congenital abnormality at birth.

Wildschut, Nas and Golding (1997) reanalyzed the predictive value of socio-demographic factors on preterm birth using the data set of the 1958 British Perinatal Mortality Survey. Their results show that in primiparous women low maternal age (under 20 years) was the only sociodemographic variable that was predictive of preterm birth and in multiparous women employment status was significantly associated with preterm birth. They concluded that sociodemographic factors do not have a substantial impact on the risk of preterm births.

Kirkup and Welch (1990), "Normal But Dead" looked into perinatal deaths which were not malformed, of birth weight 2.5 kilograms and over, in the Northern Region of Britain in 1983. The authors focused their attention on a group who were apparently well equipped to survive, but did not. Their study reports on four factors which were significantly associated with risk of these perinatal death: primigravidity, parity of 3 or more babies, mothers not booked for antenatal care by 20 weeks and birth weight of less than 3.2 kilograms. Avoidable factors were detected in 50 percent of deaths. Of the avoidable factors detected, 61 percent related to intrapartum management. Most of these involved failure to respond to
evidence of fetal distress in labour. Factors related to the intrapartum event were also related to the risk of perinatal deaths.

Baird (1980) studied the changes in environment in Britain in the last 150 years provided a unique opportunity to study the effects of environmental factors on reproduction. Using national perinatal death data of England and Scotland and comparing these rates to that of Scandinavia and the Netherlands, he showed that the causes generally associated with the mother's socioeconomic circumstances, are related to the period at which the mother herself was born and reared. Although living conditions and health in the majority of Britain improved in the 19th century, this was not true for about a third of the British lower social class population. Although advances in obstetric care reduced perinatal mortality rates, it was unlikely for these rates to be similar to Sweden where social class differences in stature have disappeared. There are no social class or regional differences in stature in Sweden, whereas in Scotland this is still obvious which indicate many women have failed to grow to a height that is genetically appropriate. Women who started childbearing in the 1990's when social conditions deteriorated and unemployment increased, were stunted, malnourished and almost certainly had high perinatal mortality from factors which were dependent on the reproductive efficiency of their mothers. On reviewing the perinatal statistics of Aberdeen and Scotland the death rates from unexplained low birth weight and from CNS malformations are closely linked to the health and physique of the mother.
A similar study was carried out in Italy by Parazzini et al (1990). The authors analyzed Italian stillbirth data for 1955 to 1979, to investigate the cause of stillbirth mortality in Italy. Their results show a decrease in still birth rates were marked in the generation of women born since 1920 and the stillbirth rate was affected in a smaller way by a period effect, thus showing that long term improvements in socioeconomic, general health and obstetric condition, acting within a generation (cohort of women), are a relevant determinant of still birth rates, along with short term advances in obstetric care (period effect).

Local

Associations between perinatal mortality and maternal socio-biological characteristics have been identified in the Maltese Islands as early as 1967. Savona-Ventura and Grech (1985) reported on the downward trends in perinatal mortality, associated with the fall in birth rates for the same period. The crude birth rate in 1969 was 15.8 per 1000 population, while in 1980 it rose again to 17.5 per 1000 population. This declining birth rate has been attributed to a number of causes which were important to consider when dealing with these mortalities. A large proportion of the population, mainly young people in their fertile years, emigrated overseas. During the same period members of the British forces and their families left the country. Along with this, the birth rate declined resulting in a decrease in family size. The mean number of live births per marriage cohort had decreased from 7.38 before the 1920's to 3.83 in the late 1940's. This shrinkage of family size was attributed to the resulting changes in
socio-economic factors and also as a result of the introduction of the concept of family control.

Having established that the crude birth rate was falling over the years and the perinatal death rate was falling at the same time as the fall in the overall birth rate local authors went on to study the associations between perinatal mortality and the social and biological characteristics of the mothers after the 1958 Perinatal Mortality Survey in Britain showed definite correlations between them.

Increasing parity has been correlated with an increased risk of perinatal mortality and morbidity, the British Perinatal Mortality Survey of 1958 has shown that at any given age, the risk of perinatal death was lowest for the second and third pregnancies and highest for the subsequent pregnancies. Locally, a comparison of obstetric outcome of the grand multipara was carried out by Busutili (1966) 'The Grand Multipara'. He showed that grand multipara was at a higher risk of obstetric problems which gave rise to adverse perinatal outcome. Another follow up study carried out by Savona-Ventura and Grech (1985), 'Analysis of perinatal deaths occurring in Malta', confirmed that this was true even in the 1980's, perinatal mortality being significantly greater in women having their first child and those having their fourth or more child.

Sultana and Calleja (1967) carried out a study on 243 perinatal deaths undergoing postmortems during the period 1957-1966, an attempt was made to compare the causes of perinatal deaths in the Maltese Islands with those of the
United Kingdom. Their findings confirm that the commonest cause of death was intrapartum anoxia, while death due to congenital malformations was the second commonest cause.

Maternal age has been repeatedly associated with influencing perinatal mortality in many countries in both the developed and developing world. Similar observations were reported locally by Savona-Ventura and Grech (1985) 'Analysis of perinatal deaths occurring in Malta'. Women over 35 years had a greater likelihood of perinatal mortality. The cause of death being mainly because of placental insufficiency which affects fetal growth and these women were also with a higher incidence of congenital abnormalities. Elderly women also had a greater incidence of premature deliveries and multiple pregnancies. In the 1960's these women accounted for 17.7 % of all deliveries in the Maltese islands while in the 1980's this was 10.7%. These authors also showed that perinatal mortality rates were also higher in women aged less than 20 years. The authors relate these mortalities in the younger age groups to premature births and influences of lower socio-economic status of these mothers.

Perinatal mortality has been associated with social and economic factors, in a study carried out by Savona-Ventura and Grech (1987), which showed that increasing maternal age and multiparity were associated with perinatal mortality, and were indirectly correlated to the social circumstances of the family. The lower socioeconomic classes were more likely to have larger families. In 1966, the prevalence of grand multipara delivering at St. Lukes hospital in Malta was
reported to be 15.75% of all admissions. The higher prevalence was attributed to the fact that larger proportion of women admitted to hospital at that time were from the lower socioeconomic strata whilst women from the higher social classes were more likely to deliver in one of the paying religious run hospitals functioning in Malta at the time. The grand multipara were shown to have a higher adverse obstetric and perinatal outcome. The incidence of premature births often associated with perinatal mortality and being commoner at the two extremes of reproductive life was 4.45% in the Blue Sisters Hospital, the only paying hospital in the period of 1947-1954. In contrast the incidence of prematurity in St. Luke's Hospital for the period of 1954-1955 was reported to be 95%. However a study carried out by Camilleri and Micallef (1976) on 407 primipara delivering at St. Luke's hospital in 1974 failed to show any definite influence of social class on maternal age and duration of gestation.

Savona Ventura and Grech (1987) reviewed hospital perinatal mortality statistics for the Maltese islands from the 1950's to the 1980's and compared them to those of European countries. They concluded that the drop in the still birth rate after the 1960's was mainly due to a decrease in birthrates whilst the early neonatal death rate exhibited a sharp drop in 1953 and then assumed a more gradual decline to an average of 10 per 1000 live births. 1953 was an important era of obstetric care in Malta because in that year eight antenatal clinics were opened in the principal towns and villages. These clinics were the first step in providing continuous prenatal care to women of the lower socio-economic groups. During the period of 1957-1966, 40.6% of all perinatal deaths were due to antepartum
and intrapartum anoxia. In 1979 to 1982, 33.6% of deaths had avoidable factors intrinsic to the hospital while 54.6% were unavoidable factors (extreme prematurity, congenital abnormality, hypertensive disorders).
Chapter 3: Aims and methods

Background on maternity care

Maternity care on the Maltese islands is mainly delivered through an integrated and comprehensive public health care system, although there are also private facilities for maternity care and delivery. The pregnant woman has the option of receiving scheduled antenatal care at the antenatal out-patient services of Karin Grech hospital (KGH), the health centre in her locality, or at a private clinic. Qualified obstetricians, general practitioners or midwives monitor and provide care for her pregnancy. When the pregnancy is categorised as high risk or there are signs of fetal or maternal problems the patients are referred to KGH for further care. At a gestational age between 12 to 15 weeks all mothers are advised to go for a booking visit at KGH. At delivery the mother again has the option to deliver her baby at a private center or at the state run public hospital (KGH). Home deliveries are not popular and have declined in recent years. Pregnant women often opt to receive a mixed form (private and public) of antenatal care and then go to KGH for the delivery of their baby, as the hospital is equipped with a Special Care Baby Unit (S.C.B.U) and provides full emergency services. Private centres cater mainly for normal pregnancies and outcomes usually under private insurance schemes, however when there is a delivery involving fetal or maternal distress, patients are usually transferred to KGH.
There were 191 perinatal and late neonatal deaths in the Maltese islands during 1993-1995. Of these, just 5 took place outside KGH. The perinatal death rate for the above period was 11.4 per thousand total births and the late neonatal death rate was 1.6 per thousand live births. The perinatal mortality rate comprised of a still birth rate of 5.7 per thousand total births and an early neonatal death rate of 5.7 per thousand live births.

**Data Sources used in this Study**

1. Maternity Information System

Karin Grech hospital is a state run public hospital which houses the maternity and pediatric services. It is situated within the only main acute hospital complex of the island. The Maternity Information System (MIS) data show that Kgh accounted for about 90 percent of the total births. Data collection for the MIS commences once the mother delivers her baby, information regarding the course and outcome of pregnancy is recorded onto a standard maternity information sheet. This sheet comprises of 4 sections, and collects information about the mother, the booking visits, the delivery and the infant (see annex 1). This sheet is the main data source for the MIS, which was jointly set up by the department of Health Information (DHI) and the department of Obstetrics and Gynecology in 1991. The main objective of this system is to provide information on obstetric care and outcomes, to clinical and managerial professionals. The collection of data regarding the event is carried out by two nurses situated at the post-natal ward. Once the delivery has taken place, the nurses gather the relevant data from
various sources: the co-operation card (Blue Card), nursery notes kept at the Post-Natal ward, the infant file when the baby is admitted to S.C.B.U. and the baby book kept at Labour ward. When information is lacking from these sources the nurses have the opportunity to ask the mother the relevant information while at the post-natal ward or trace the relevant information from the patient's case notes. Once the information is gathered and the standard maternity sheet is filled, the sheets are taken to the DHI. At the DHI, a data entry operator gives each sheet a unique delivery identification number and validates the recorded maternal identification against the Patient Master index (PMI). The PMI is part of a comprehensive Healthcare Information System that holds demographic details on all residents of the Maltese Islands. The sheets are then given to a medical officer at the DHI for coding. The International Classification of Disease, revision 9 (ICD-9) is used to code past medical conditions, antenatal conditions and the discharge diagnosis of the infant. Once the sheets are coded, data are entered into a dBase IV program. The maternity information database is composed of 4 main files: MATER: (records Maternal identification), BOOKDEL: (records booking information), DELNEW: (records information on the delivery) and INFANT1: (records information on the infant). In 1993 and 1994, validation of data was carried out whenever obstetric information was requested. However in 1995 data was validated at the end of the calendar year in order to issue the annual report. In view of the change in methods of validation, the maternity information sheets for all cases of perinatal and neonatal mortality were reviewed individually for the purpose of this dissertation and the data were entered into an Excel spreadsheet for all relevant variables under study. Variables relating the socio-biological
characteristics of the mother to outcome (stillbirth, early and late neonatal mortality) were as follows: basic information about patient identification are maternal age, height, weight at booking, locality of residence, marital status, present smoking history habits and patient's past obstetric history. Relevant antenatal data gathered included the pregnancy risk status, site of antenatal care in the last 4 weeks of gestation and the antenatal problems. Data relating to delivery were presentation/lie of fetus and type of delivery. Information collected on the fetus or neonatal death included gender, birthweight, congenital abnormality detected at birth or in the neonatal period, gestation at term and the discharge diagnosis of infant (see annex 1).

2. Perinatal and Neonatal Mortality Register

Further information on the cause of still births and neonatal deaths was obtained by reviewing the perinatal and neonatal mortality register, kept at the National Mortality Registry within DHI. Stillbirths and neonatal deaths in the Maltese islands are notifiable by law under the Medical and Kindred Professional Ordinance. Doctors notify by completing the appropriate Still birth Certificate and Death certificate in the case of stillbirths and neonatal deaths respectively, which is submitted to the Police. These certificates are then forwarded to the DHI after the issue of a burial permit. At this department the death certificates are processed and regular monthly validation is done on the data. The death certificates are registered into the National Death Register on computer. Routine analysis of data takes place and information is sent to the Central Office of
Statistics (COS) and the World Health Organisation as well as being published by the DHI itself.

3. Acts of Births and Deaths

The only socio-economic attribute recorded on the maternity information sheet is marital status. In order to obtain further information on the socio-economic status of these mothers, data on partners occupation were retrieved from the information sheets of the Acts of Births and Deaths which is kept at the department of Central Office of Statistics. The search for partners occupation was done manually searching through the sheets for date of birth, mothers and fathers name and surname. However 30 % of the total study population lacked information on occupation of partner although a search was carried out six weeks after the stated date of delivery. Probably this was because the birth or stillbirth was registered at a later period after delivery. This made manual retrieval of paternal occupation difficult because there was no way of knowing in which month the registration of the event took place.

Methods

Perinatal and neonatal mortality has been studied by researchers using different epidemiological methods, mainly on population or hospital based settings. Various studies have used different sources of information to analyse national or hospital perinatal and neonatal deaths, to mention a few: Hospital Inpatient Enquiry Maternity (Mascarenhas and Eliot 1992), Office of Population and
Census Surveys and the General Health Questionnaire (MacDonald, Peacock and Anderson 1992) and Institut National de la Sante et de la Recherche Medicale (Blondel et al 1987), computer stored data: Mc Gill obstetric database (Fretts and Usher 1997).

This was a case control study which used the MIS as its main data source. A case-control method of analysis was chosen, firstly because data already exist on a computer database program, which uses information that has been collected prospectively. Secondly, the maternity information system uses standard methods of data collection and recording (annex1) for all maternities; Lastly because the main data sources and the professionals that collect, record and input data into the system have remained the same over the three year period. Although the MIS was initiated in 1991, it was not until 1993 that data collection methods and inputting have been consistent and complete, hence the study period covers 1993 to 1995. A three year period was considered because perinatal and neonatal mortality figures for a single year are small. Primaparous and multiparous outcomes that resulted in fetal and neonatal deaths have been included in this study. The aim of this study was to obtain relevant biological, sociological, and obstetric data in order to look into the associations between these risk factors and perinatal/neonatal mortality, so as to be able to answer the questions of how often and why these babies die and with what clinico-pathological associations, and thus to provide information that may enable better maternity care to these high risk women.
Definitions on still birth, live birth, perinatal mortality and neonatal deaths are given in annex 2.

**Study Population**

**Cases**

Of the 191 perinatal and neonatal deaths, occurring from 1993 to 1995, 184 (95%) deaths have been registered into the MIS. This study focuses on these deaths as the MIS is the main data source that records data on socio-biological variables. Deaths occurring in Gozo, in private hospitals were excluded from this study. These deaths were excluded because most of the relevant information needed for this study were missing on the mothers case notes and also because the collection of information would have been retrospective and would differ from the standard way of prospective information collection.

**Controls**

Analysis of perinatal and neonatal deaths for 1993-1995 were to be compared to the general live birth population. These controls were extracted from the Maternity Information System by the head of the Computer Services Branch at the DHI. A computer program was created to select random record numbers of live births within the database. For each case two controls were selected, thus in all 368 controls were chosen for this study. The randomly selected record number files
were then copied on to an Excel 4 spreadsheet. The baseline requirement considered was that of live births, making this a good representative sample of the population.

**Variables**

Several socio-biological variables suspected of an association with perinatal and neonatal deaths based on previous published work were taken from the MIS for this study (see annex 1). This social factors considered in this study were paternal occupation, marital status, cigarette smoking, type of antenal care, maternal age and locality of residence (annex 3). Biological risk factors considered were maternal age, parity and body mass index calculated by recorded height and weight(\(wt/ht^2\)). The outcome of pregnancy selected for this study were birthweight of less or more than 2500 grams, preterm delivery defined as births occurring before 37 weeks and causes of fetal and neonatal death. Other characteristics specific to the pregnancy which were also included in this study were type of delivery, infant gender and the pregnancy risk status. Information on other social and lifestyle variables like alcohol, drug use, employment status of mothers are not included in the standard form and thus were not included in this study. This study explored the socio-biological risk factors that are recorded in the MIS.

The objective of this study was to identify socio-biological risk factors which may play a role into the cause of these deaths. In order to determine how these cases differed from the babies who did not die, a case control study was carried out. With the exception of details relating to death, the same information is collected for the controls as for the cases.
Statistical analysis

Cross tabulation from the Excel 4 software was used to retrieve the proportion of cases and controls according to the independent variables used. Epi-info statcalc and epi-table function will be used to calculate odds ratio (OR), confidence intervals and chi-square.
Chapter 4: Results and analysis

The total study population comprised of 552 live births and fetal or neonatal deaths. Of these 184 were fetal and neonatal deaths (cases) and 368 were live births (controls).

Among the births that occurred at KGH between 1993 and 1995, 92 resulted in stillbirths, 73 in early neonatal deaths and 19 in late neonatal deaths. The statistical tests used in this study to determine significance of difference between the two groups of pregnancy outcomes were crude odds ratios (OR) and chi square. Data that was available for the specific variables were analysed, missing data have not been included in the statistical analysis.

Perinatal and neonatal risk factors analysed

Maternal age

Maternal age was obtained from the MIS and was analysed in this study as a social and biological risk factor associated with perinatal or late neonatal mortality. The mean age of mothers in the case group was 29.4 whilst in the controls was 27.8. The age range of the study population was 14 to 47 years. Fetal and neonatal deaths were compared to live births according to the two groups, those which occurred in mothers aged less than 30 years and those equal to or more than 30 years of age (see Table1). The distribution of stillbirth and
neonatal deaths were almost equal between the two age groups whilst in the live births, 64 percent of births occurred in women less than 30 years and 36 percent occurred in women 30 years of age and over. Statistical analysis carried out using chi-squared showed that there was a strong significant difference between these two age group of women with regard to outcome ($\chi^2 = 8.6$, p value $<0.0003$).

Table 1: Stillbirth and Neonatal deaths according to age.

<table>
<thead>
<tr>
<th>Mothers' age (yrs.)</th>
<th>Live births</th>
<th>Stillbirths</th>
<th>Neonatal deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>&lt;30</td>
<td>234</td>
<td>64</td>
<td>41</td>
</tr>
<tr>
<td>=&gt;30</td>
<td>134</td>
<td>36</td>
<td>51</td>
</tr>
</tbody>
</table>

Maternal age was further categorised into 5 age groups (<20, 20-24, 25-29, 30-34 and 35+ yrs) and the outcome of pregnancy was compared between the cases and controls. Chi-square for linear trend showed there was a significant difference between the variables and also there was a significant trend ($\chi^2$ for linear trend = 7.87, df=4, p value = 0.005. (Table 2).

Table 2: Maternal age according to outcome of pregnancy.

<table>
<thead>
<tr>
<th>Maternal age (years)</th>
<th>Deaths (Cases)</th>
<th>Live Births</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>&lt;20</td>
<td>10</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>20-24</td>
<td>29</td>
<td>16</td>
<td>73</td>
</tr>
<tr>
<td>25-29</td>
<td>54</td>
<td>29</td>
<td>138</td>
</tr>
<tr>
<td>30-34</td>
<td>54</td>
<td>29</td>
<td>93</td>
</tr>
<tr>
<td>35+</td>
<td>37</td>
<td>20</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>184</td>
<td>100</td>
<td>368</td>
</tr>
</tbody>
</table>

Note: 1* reference group
Marital Status

Marital status was classified as never married or married. Births from mothers who were widowed, divorced or separated were included in the married category as they had been married at some time. These births were almost equally distributed among the two groups. Marital status on the MIS is recorded at the first encounter with the antenatal services. Marital status in the two groups was compared according to the outcome of pregnancy and found to have no significant difference between the groups (OR= 2.34, CI= 0.76-7.31). (Table 3).

Table 3: Marital Status according to outcome.

<table>
<thead>
<tr>
<th>Marital Status</th>
<th>Deaths (Cases)</th>
<th>Live Births</th>
<th>Crude OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Never married</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/ once</td>
<td>175</td>
<td>96</td>
<td>359</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>100</td>
<td>366</td>
</tr>
</tbody>
</table>

Paternal occupation

Paternal occupation was retrieved from the registered information on the of births and stillbirths kept at the Central Office of Statistics (COS). Occupation was classified according to the Demographic Review (DR) which publishes births by occupation of father. The DR is an annual publication by the COS, which reports on the country’s national demographic data. COS uses the International Standard Classification for Occupation (ISCO-88) for coding occupation. There were 7 perinatal deaths which were registered to mothers of unknown partners;
these were excluded from the analysis. Occupations were grouped into 10 levels and further grouped into two major categories, Non-manual (level 1-4) and Manual (level 5-10). On comparing the two major occupational groupings in the deaths (cases) and live births (controls), it was found that there was no significant difference between the occupational groups and the cases and controls (OR= 0.87, 95% C.I= 0.55-1.37). Thus paternal occupation was not found to be associated as a risk factor for these deaths (Table 4).

Table 4: Occupation according to outcome.

<table>
<thead>
<tr>
<th>Occupational class (Paternal)</th>
<th>Deaths (Cases)</th>
<th>Live Births</th>
<th>Crude OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Non-manual (1-4)</td>
<td>50</td>
<td>37</td>
<td>103</td>
</tr>
<tr>
<td>Manual (5-10)</td>
<td>84</td>
<td>63</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>134</td>
<td>100</td>
<td>254</td>
</tr>
</tbody>
</table>

**Body Mass Index (BMI)**

A BMI of less than 25 was considered as representing normal weight, a BMI of 25-29 as overweight and a BMI exceeding 30 as obese (Garrow in Bellizzi 1992). Body mass index was calculated from the height and weight of the mother recorded at the booking visit in the MIS. The mean weight and height of mothers whose pregnancies resulted in fetal or neonatal death were 66.3 kilograms and 156.7 cms. Whilst in mothers whose pregnancy resulted in a live birth, the mean weight was found to be 65.6 kilograms and the mean height to be 157.8 cm. On analysing the data according to outcome in the two groups and taking the reference BMI as less than 25, there was no significant difference between the groups. (Table 5).
Table 5: Body mass index according to outcome.

<table>
<thead>
<tr>
<th>Body Mass Index (kg/m²)</th>
<th>Deaths (Cases)</th>
<th>Live Births</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>&lt;=24</td>
<td>64</td>
<td>41</td>
<td>126</td>
</tr>
<tr>
<td>25-29</td>
<td>56</td>
<td>37</td>
<td>136</td>
</tr>
<tr>
<td>30+</td>
<td>33</td>
<td>22</td>
<td>68</td>
</tr>
<tr>
<td>Total</td>
<td>153</td>
<td>100</td>
<td>330</td>
</tr>
</tbody>
</table>

Note: 1* reference group

Smoking

Maternal cigarette smoking habits were taken from the MIS which records the smoking habits of the mother at the onset of pregnancy. Although there are 9 categories listed on the quantity of cigarettes smoked (annex 1), data on the smoking habits of the mother were poorly recorded. In the period under investigation there were 42% (78) for which there was no record of the mothers' smoking habits and 61% (226) live births that had missing data. In order to analyse data that were available, smoking habits of mothers were categorised into two groups, those who never smoked and those who smoked. The resulting births and deaths were compared to the mothers smoking habits. No association was found between maternal smoking and outcome (OR=1.31, C.I= 0.59-2.89). (Table 6).

Table 6: Maternal smoking habits according to outcome of pregnancy.

<table>
<thead>
<tr>
<th>Cigarette smoking (Maternal)</th>
<th>Deaths (Cases)</th>
<th>Live Births</th>
<th>Crude OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>No</td>
<td>90</td>
<td>85</td>
<td>125</td>
</tr>
<tr>
<td>Yes</td>
<td>16</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>100</td>
<td>142</td>
</tr>
</tbody>
</table>
Parity

Parity was determined from the mother’s past obstetric history, as recorded in the MIS, and grouped into those who were primigravidae, those who had 1 to 2 babies born alive before the present pregnancy and those who had 3 or more babies. On analysing the data using mothers with 1 or 2 babies as the reference group, it was found that the difference between primipara and women having more than 3 babies just missed the 5% significance level (Table7).

Table 7: Parity according to outcome.

<table>
<thead>
<tr>
<th>Parity</th>
<th>Deaths (Cases)</th>
<th>Live Births</th>
<th>Crude OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>0</td>
<td>95</td>
<td>52</td>
<td>165</td>
</tr>
<tr>
<td>1-2</td>
<td>72</td>
<td>39</td>
<td>180</td>
</tr>
<tr>
<td>3+</td>
<td>16</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>100</td>
<td>365</td>
</tr>
</tbody>
</table>

Note: 1* is the reference group

Antenatal Care Site

The site of antenatal care in the last 4 weeks of pregnancy was recorded in the MIS and used in analysis of data to see whether there was an association between the site of antenatal care (ANC) and perinatal outcome. On comparing the ANC site between the two groups it was found that there was no association between the site of care and the outcome of pregnancy (Table 8).

Table 8: Antenatal care related to outcome.

<table>
<thead>
<tr>
<th>Antenatal Care</th>
<th>Deaths (Cases)</th>
<th>Live Births</th>
<th>Crude OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>KGH or HealthCentre</td>
<td>47</td>
<td>26</td>
<td>86</td>
</tr>
<tr>
<td>Private</td>
<td>50</td>
<td>28</td>
<td>106</td>
</tr>
<tr>
<td>Mixed</td>
<td>82</td>
<td>46</td>
<td>172</td>
</tr>
<tr>
<td>Total</td>
<td>179</td>
<td>100</td>
<td>364</td>
</tr>
</tbody>
</table>

1* reference group
Gestational age

Gestational age at delivery was calculated from the date of delivery and the date of last menstrual period based on the data recorded on the maternity information sheet. The gestational age range was 22 to 41 weeks in the deaths and 28 to 41 weeks in the live births. In the study population 15 percent of live births and 76 percent of fetal and neonatal deaths took place before 37 weeks while there were 85 percent of live births and 24 percent of fetal or neonatal deaths that took place after 37 weeks of gestation. On comparing the deaths to births according to the two groups of gestational age, it was found that there was a significant difference between these groups (OR=18.02, C.I=11.24-29.00). (Table 9)

Table 9: Gestational age according to outcome of pregnancy.

<table>
<thead>
<tr>
<th>Gestation at delivery (wks)</th>
<th>Cases (n:178)</th>
<th>Controls (n:364)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stillbirths</td>
<td>Early neonatal deaths</td>
</tr>
<tr>
<td>&lt;37 weeks</td>
<td>66</td>
<td>55</td>
</tr>
<tr>
<td>&gt;37 weeks</td>
<td>21</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: \( \chi^2=195.6, p\text{value}<0.0001 \)

Perinatal and neonatal deaths were further split into stillbirths and early and late neonatal deaths and compared according to smaller gestational age categories. It was found that the greatest number of stillbirths occurred between a gestational age of 32 to 37 weeks while early neonatal deaths occurred more often before a gestational age of 28 weeks (Table 10).
Table 10: Gestational according to stillbirths and neonatal deaths.

<table>
<thead>
<tr>
<th>Gestation (weeks)</th>
<th>Stillbirths n</th>
<th>Stillbirths %</th>
<th>Early neonatal deaths n</th>
<th>Early neonatal deaths %</th>
<th>Late neonatal deaths n</th>
<th>Late neonatal deaths %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;28</td>
<td>16</td>
<td>18</td>
<td>27</td>
<td>40</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>28-31</td>
<td>20</td>
<td>23</td>
<td>10</td>
<td>15</td>
<td>7</td>
<td>39</td>
</tr>
<tr>
<td>32-37</td>
<td>30</td>
<td>35</td>
<td>18</td>
<td>25</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>38-40</td>
<td>19</td>
<td>22</td>
<td>18</td>
<td>25</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>41+</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

Birth weight

Birth weights were obtained from the MIS and the Perinatal and Neonatal Mortality Register. The mean birth weight in the cases and controls were 1710 grams and 3260 grams respectively. The birth weights in the study population ranged from 450 to 4200 grams. Birthweights were categorised into two groups, those less than 2500g and those equal to or more than 2500 g and compared to in the cases and controls (deaths and live births). On analysing birthweights using odds ratio, a significant difference between the case and control group was found for the outcome of the pregnancy (OR=46.39, C.I=46.39-85.32). (Table 11).
Table 11: Birthweight according to outcome.

<table>
<thead>
<tr>
<th>Birth weight (grams)</th>
<th>Cases (n:177)</th>
<th>Controls (366)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stillbirth</td>
<td>Early NND</td>
</tr>
<tr>
<td>&lt;2500</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>59</td>
<td>47</td>
<td>55</td>
</tr>
<tr>
<td>=&gt;2500</td>
<td>29</td>
<td>58</td>
</tr>
</tbody>
</table>

Chi-square=268.87, p value=<0.0001.

Birthweight was further grouped into very low birth weight (<1500g), low birth weight (1500-2499g), birth weight of 2500 to 3499 grams and more than 3500 grams, and analysed according to outcome of birth. It was found that in the deaths, 47 percent occurred at very low birth weight, 24 percent at low birth weight and 28 percent at more than 2500 grams. On the other hand there was 94 percent of the live births were born at a weight range of more than 2500 grams and 5 percent at low birth weight. (Chart 1)

Chart 1: Birth weight according to outcome.
Gender of infant

On comparing the study population according to the gender of the birth or death, it was found that the female to male ratio was similar in the deaths and live births (1:1.2 and 1:1.1 respectively). Further analysis using Odds ratio showed no difference between the two groups (OR=0.99, C.I=0.62-1.49). (Table 12).

Table 12: Outcome according to gender.

<table>
<thead>
<tr>
<th>Infant Sex</th>
<th>Stillbirths</th>
<th>Early neonatal deaths</th>
<th>Late neonatal deaths</th>
<th>n</th>
<th>%</th>
<th>Live births</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>42</td>
<td>41</td>
<td>13</td>
<td>96</td>
<td>52</td>
<td>194 (53%)</td>
</tr>
<tr>
<td>Female</td>
<td>49</td>
<td>31</td>
<td>6</td>
<td>86</td>
<td>47</td>
<td>174 (47%)</td>
</tr>
<tr>
<td>Indeterminate</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

Locality of residence

The locality of residence of these births and deaths was obtained from the MIS and categorised into the 5 regions as published in the DR (annex 2). On analysing locality according to outcome of both groups it was found that locality of residence was not associated as a risk factor. Statistical analysis using Odds ratio for linear trends showed no significant difference between the regions (Table 13).

Table 13: Distribution of study population according to regions.

<table>
<thead>
<tr>
<th>Regions</th>
<th>Cases</th>
<th>Controls</th>
<th>Crude OR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Inner Harbour</td>
<td>29 (16)</td>
<td>70 (20)</td>
<td>0.73</td>
</tr>
<tr>
<td>Northern</td>
<td>20 (11)</td>
<td>61 (17)</td>
<td>0.58</td>
</tr>
<tr>
<td>Western</td>
<td>32 (18)</td>
<td>59 (17)</td>
<td>0.96</td>
</tr>
<tr>
<td>South East</td>
<td>34 (19)</td>
<td>51 (14)</td>
<td>1.18</td>
</tr>
<tr>
<td>Outer Harbour</td>
<td>66 (36)</td>
<td>117 (32)</td>
<td>1*</td>
</tr>
<tr>
<td>Total</td>
<td>181 (100)</td>
<td>358 (100)</td>
<td></td>
</tr>
</tbody>
</table>
Method of delivery

The type of delivery used in this analysis was retrieved from information recorded in the MIS. The data were categorised into vaginal delivery, which included breech deliveries without the use of instrumentation, and Instrumental delivery, which included ventouse and forceps deliveries. Caesarean section deliveries in the cases comprised of 7 births being delivered by elective caesarean section and 35 births by emergency Caesarean section. For the purpose of calculating the Odds ratio instrumental deliveries that resulted in deaths were excluded in the analysis because the numbers were small and also because there were no live births delivered through this method in this study. On comparing births and deaths delivered by the vaginal and caesarean methods, an association was found at 95 percent confidence level ($\chi^2=5.2$, p value=0.02). The table below gives the number and frequency percentages between the types of delivery and the births and deaths (see Table 14).

Table 14: Mode of delivery according outcome of pregnancy.

<table>
<thead>
<tr>
<th>Type of delivery</th>
<th>Deaths (n:184)</th>
<th>Live births (n:366)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Vaginal</td>
<td>139</td>
<td>76</td>
</tr>
<tr>
<td>Instrumental</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Caesarean section</td>
<td>42</td>
<td>23</td>
</tr>
</tbody>
</table>

Pregnancy risk status

Mothers are categorised into high or low risk depending on her present and past medical and obstetric condition. The high risk status criteria used in KGH is a standard list of conditions which have known to complicate pregnancy. On
comparing the risk status to the outcome of pregnancy in the two groups, it was found that there was a strong association between the risk status and the perinatal outcome ($\chi^2=44.88$, p value=0.0001) see Table 15.

Table 15: Pregnancy risk status acc.to deaths and births.

<table>
<thead>
<tr>
<th>Pregnancy risk status</th>
<th>Cases n=179</th>
<th></th>
<th>Controls n=376</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Low risk</td>
<td>93</td>
<td>52</td>
<td>292</td>
<td>80</td>
</tr>
<tr>
<td>High risk</td>
<td>86</td>
<td>48</td>
<td>74</td>
<td>20</td>
</tr>
</tbody>
</table>

Causes of fetal and neonatal death

The causes of fetal death were retrieved from the MIS and the Perinatal and Neonatal Mortality Register. In 1995 the National Mortality Register used the International Classification of Disease revision 10 (ICD-10) for classifying the certified causes of death while in 1993 and 1994 the causes of death were classified according to ICD revision 9 (ICD 9). The MIS used ICD-9 to classify all recorded infant discharge diagnosis in all the three years under study. In order to bring uniformity in the categorisation of recorded causes of deaths, the causes of death that were coded in ICD-9 was recoded using ICD-10 for this study.

All causes of death and not only the underling cause of death were studied to analyse all causes of perinatal and neonatal mortality. Because more than one factor can contribute to fetal deaths, the cause of death do not add up to the number of deaths. Of the causes of deaths recorded 10 (4%) was attributed to pregnancy, child birth and the puerperium (O00-O99), 211 (76%) was recorded
due to certain conditions originating in the perinatal period (P00-P96) and 56 (20%) were a result of congenital malformation, deformations and chromosomal abnormalities (Q00-Q99). Certified causes Q00-99 and P00-P96 were further analysed according to very low-birthweight, low-birthweight and appropriate birthweight (>2500g). On comparing these causes to the birthweight groups, it was found that there was a strong association between cause O00-99/P00-96 and the birthweight categories ($\chi^2$ of 19.3 and p value of <0.0001). The table below gives the different causes of death as recorded on MIS and the Mortality register.

Table 16: Causes of death according to ICD 10 categories.

<table>
<thead>
<tr>
<th>ICD-10</th>
<th>Description category</th>
<th>Causes diagnosed at death</th>
</tr>
</thead>
<tbody>
<tr>
<td>O30-O48</td>
<td>Maternal care related to the fetus &amp; amniotic cavity &amp; possible delivery problems</td>
<td>7</td>
</tr>
<tr>
<td>O60-O75</td>
<td>Complications of labour &amp; delivery</td>
<td>3</td>
</tr>
<tr>
<td>P00-P04</td>
<td>Fetus/newborn affected by maternal factors &amp; by complications of pregnancy, labour &amp; delivery</td>
<td>12</td>
</tr>
<tr>
<td>P05-P08</td>
<td>Disorders related to the length of gestation &amp; fetal growth</td>
<td>26</td>
</tr>
<tr>
<td>P20-P29</td>
<td>Respiratory &amp; cardiovascular disorders specific to the perinatal period</td>
<td>77</td>
</tr>
<tr>
<td>P35-P39</td>
<td>Infections specific to the perinatal period</td>
<td>7</td>
</tr>
<tr>
<td>P50-P61</td>
<td>Haemorrhagic &amp; haematological disorders of fetus &amp; newborn</td>
<td>9</td>
</tr>
<tr>
<td>P70-P74</td>
<td>Transitory endocrine &amp; metabolic disorders specific to fetus &amp; newborn</td>
<td>1</td>
</tr>
<tr>
<td>P75-P78</td>
<td>Digestive system disorders of fetus &amp; newborn</td>
<td>2</td>
</tr>
<tr>
<td>P90-P96</td>
<td>Other disorders originating in the perinatal period</td>
<td>77</td>
</tr>
<tr>
<td>Q00-Q07</td>
<td>Congenital malformations of the nervous system</td>
<td>11</td>
</tr>
<tr>
<td>Q10-Q18</td>
<td>Congenital malformations of eye, ear, face &amp; neck</td>
<td>1</td>
</tr>
<tr>
<td>Q20-Q28</td>
<td>Congenital malformations of the circulatory system</td>
<td>11</td>
</tr>
<tr>
<td>Q30-Q34</td>
<td>Congenital malformations of the respiratory system</td>
<td>5</td>
</tr>
<tr>
<td>Q35-Q37</td>
<td>Cleft lip &amp; cleft palate</td>
<td>2</td>
</tr>
<tr>
<td>Q38-Q45</td>
<td>Other congenital malformations of the digestive system</td>
<td>4</td>
</tr>
<tr>
<td>Q60-Q64</td>
<td>Congenital malformations of the urinary system</td>
<td>4</td>
</tr>
<tr>
<td>Q65-Q79</td>
<td>Congenital malformations &amp; deformations of the musculoskeletal system</td>
<td>7</td>
</tr>
<tr>
<td>Q80-Q89</td>
<td>Other congenital malformations</td>
<td>6</td>
</tr>
<tr>
<td>Q90-Q99</td>
<td>Chromosomal abnormalities, not elsewhere classified</td>
<td>5</td>
</tr>
</tbody>
</table>
Causes of death according to birth weight

The deaths were further evaluated according to birth weight for causes that was recorded due to certain conditions originating in the perinatal period (P00-P96) and causes recorded due to congenital malformations, deformations and chromosomal abnormalities (Q00-Q99). The percentage of deaths attributed to causes, Q00-Q99 and P00-P99, in very low birth weights (<1500g) were 12% and 50% respectively while in low birth weights (1500-2499g) 37% and 22% were attributed due to causes Q00-Q99 and P00-P99 respectively. On the other hand in deaths of more than 2500 grams it was found that 51% were attributed to causes Q00-Q99 while 27% was due to causes P00-P99. (Chart2).

Chart 2: Causes Q and P according to birthweight.

Note: P00-P96 (Certain causes originating in the perinatal period. Q: Q00-Q99 (Congenital malformation, deformation and chromosomal abnorm.)
Chapter 5: Discussion and conclusions

Discussion

Infant mortality is considered as a measure of socio-economic development, while perinatal and late neonatal mortality usually reflects the health status of women and the quality of health care during pregnancy, and in the perinatal and neonatal period. This study has combined 3 years (1993, 1994 and 1995) of data to show the effects of socio-biological risk factors on these mortalities. A total of 13580 births were recorded as occurring in KGH during the 3 years under study of which 184 were identified to have died in the perinatal and late neonatal period. The biggest limitation in this case controlled study has been the relatively small numbers in the various risk factors under investigation. This along with the lack of standardisation has made it difficult to show the effects of some of the risk factors, this has also interfered with understanding some of the questions put forward in this study. In spite of these limitations some of the risk factors have been identified, probably several more years of data are required to reach definite conclusion.

The department of Obstetrics and Gynaecology at KGIII carries out regular perinatal mortality and morbidity audit meetings, in order to evaluate prenatal care and intrapartum management surrounding birth scientifically and continuously. At these meeting the professionals analyse obstetric, medical and social factors with may have led to an adverse pregnancy outcome after careful evaluation of the
case file of the mother and post-mortem reports. The purpose of these meetings are primarily aimed at defining needs and improving the delivery of obstetric care to women in pregnancy.

The analysis in this study has considered specific socio-biological risk factors which have known to result in adverse pregnancy outcomes (Butler and Bonham 1963, Butler and Alberman 1969), modifying a few of the variables according to what was available. All the information needed to conduct this study was collected prospectively through standard routine data collection systems, eliminating many possible sources of systematic error. Another advantage in carrying out this study has been the homogeneity of the population, where access to adequate prenatal and obstetric care is good.

**Type of Antenatal Care**

The number of antenatal visits during pregnancy recommended by the department of Obstetrics and Gynaecology, in mothers at known low risk are as follows: one visit per month during the first and second trimesters of pregnancy, one visit every two weeks from the 28 to the 36th week and weekly visits thereafter till term. The total number of visits for a woman in a low risk category is averagely about 12 visits. In high risk pregnancies the number of visits is largely dependent on the results of routine screening and feto-placental monitoring and on her medical condition. There are no recommended number of visits in mothers at high risk. On the Maltese islands the pregnant woman has the opportunity either to receive care at a private clinic, a health centre at her locality, at the antenatal clinic at KGH or receive a mixed form (private and public) of prenatal
care. Antenatal care is shared by general practitioners, midwives and obstetric professionals although the majority of women opt for specialist care alone either at a private clinic or at KGH. The place of antenatal care in the last four weeks of pregnancy which was recorded in the MIS was used in this study as an indirect measure of socio-economic status of these births and deaths. On comparing the type of antenatal care received to the outcomes of pregnancy it was seen that there was no association between the type of antenatal care in the last four weeks of pregnancy and the outcome of pregnancy. There was an almost equal distribution of prenatal care received by mothers between KGH and the private centres in both groups. The probable reason why the type of antenatal care was not predictive of the outcome of pregnancy was because obstetric care in the state and private centres are fully equipped with modern monitoring and resuscitation devices, mothers are cared for by expert medical and nursing professionals. The result obtained in this study was in agreement with Mascarenhas et al 1992. However understanding the role of antenatal care in birth outcomes is still a challenge because it is difficult to predict abnormality or complication of pregnancy with an great certainty. It is also difficult to fully understand the benefit of routine prenatal monitoring and screening. This study did not evaluated the effect on mothers who failed to attend antenatal visits, the number of antenatal visits received by the mother throughout her pregnancy, the content of care received and whether antenatal care was adequate, largely because data on these variables are not recorded. These factors may possibly provide alternative explanations for the occurrence of these mortalities. MCLaughlin et al 1992 found that a multidiciplinary approach to prenatal care in a
hospital setting significantly increased mean birth weight among first born infants in low income mothers.

Probably future studies that look into perinatal mortality should evaluate gestation at booking and the characteristics of antenatal visits to be able to assess the influence of women who book before the 17 week and women who book later in order to see if the outcome of pregnancy is influenced by the type, frequency and content of prenatal care.

**Pregnancy Risk Status**

Pregnancy risk status, is an obstetric classification which classifies the mother into a high or low risk status in order to determine the level of supervision needed during her pregnancy and also to evaluate the type of antepartum or intrapartum management needed before and at delivery. Pregnancy risk status is assigned to the mother after her booking visit either at KGH or in the private clinics. A high or low risk status is given to mother after evaluating her demographic, social, behavioural, medical and previous obstetric characteristics. Women with in an age group of 20 to 29 years and with no previous obstetric or medical complications are assigned as low risk. Women in a low risk category who may change into high risk due to an adverse situation are categorised from then on as high risk. However it is difficult to define risk as it depends on the ability to predict abnormality or complications, therefore there is an increasing tendency for obstetricians to define more and more risk factors in an attempt to include all possible problems. On comparing the risk status to the outcome of pregnancy in the two groups of study population (deaths and live births), it was found that there was a significant difference between the risk status and the outcome of pregnancy. In the cases 48 % of deaths occurred in high risk category while 52
% of deaths were assigned to low risk status. In contrast 80% of all live birth were categorised as low risk and 20% of live births were categorised as high risk. It is difficult to interpret this data largely because there is no standard risk grading system and also because of the difficulty of identifying mothers "at risk". It is difficult also to interpret why 52 percent of the deaths were assigned to low risk, and whether their risk status changed during labour, whether they failed to attend or whether the number of visits were appropriate. Screening methods used are usually selective to known high risk mothers and it is difficult to evaluated what causes mothers to go into labour (early, late or on time). Management of pregnancy are not preventive or curative but symptomatic and rely heavily on investigation and screening. Probably the proportion of deaths in the high risk category were relatively less than the deaths in the low risk category because of closer supervision and feto-placental monitoring of pregnancy by their obstetricians either at out-patients or as an admission to the antenatal ward in KGH. On comparing risk status of the mother and the place of antenatal care received in the last four weeks of pregnancy it was found that mothers who were are at high risk tended to be cared for at KGH and also have a mixed (private and public) form of prenatal care, probably because they were more worried and need to see their obstetrician, more often.

**Type of delivery**

This study analyses the mode of delivery between the deaths and live births in order to see whether the type of delivery was associated to the outcome of pregnancy. The choice of the method of delivery of the baby is largely dependant on fetal and maternal factors and these factors also determine the level of
specialised care needed at the time of delivery. Midwives are most often in attendance in vaginal deliveries of the baby while for an instrumental or caesarean section a consultant or senior registrar is required and hence the latter require closer specialist-patient relationships. On comparing births and deaths delivered by vaginal and caesarean methods, an association was found at 0.05 significance level. There were more caesarean sections (23%) carried out in perinatal and neonatal deaths than live births (15%), although there were more deaths delivered by the vaginal methods (76%). The type of delivery is indirectly related to these deaths as often fetal distress or the death of the fetus indicate the type of delivery rather than the mode of delivery be implicated in the death. Caesarean sections were more in the deaths probably because of the high risk pregnancies, breech presentations and early gestations. There were more early neonatal deaths delivered by caesarean sections, as stillbirths are less frequently delivered by this method, also because caesarean sections are performed readily for severe pre eclampsia or fetal distress. On the other hand it is known that caesarean sections complicate more often with respiratory distress syndromes and hyaline membrane disease (Butler ans Alberman 1969), this study however did not evaluate the indication for caesarean section.

**Marital Status**

Marital status was taken as a socioeconormic variable in this study to analyse the whether social-economic characteristics were predictive of adverse pregnancy outcome. In the study population there were a total of 8 (4%) deaths and 7 (2%) births that occurred in mothers who were never married and 175 (96%) deaths and 359 (95%) births occurred in mothers who were married presently or at some
time (of the 95 percent who were married less than one percent were separated or widowed). Marital status was not found to be significantly different in the two groups. Probably this study failed to show a significant difference between the married and unmarried category of women due to the small numbers of single status births and deaths. It is difficult to comment on the results of this analysis except that the proportion of births and deaths in the married category made up 97% of the total study population. Studies that have looked into the effects of marital status on outcomes of pregnancy have illustrated conflicting results of the association of marital status on perinatal and neonatal mortality. Past studies that have shown marital status to be an important risk factor in perinatal and neonatal mortality were Butler and Bonham 1963, Butler and Alberman 1969, Golding 1987. On the other hand more recent studies have shown that marital status is not associated with adverse outcomes Mac Donald et al 1992; Fraser et al 1995.

**Maternal age**

Maternal age was considered in this study as a social and biological risk factor affecting pregnancy outcomes. Age was considered as a social factor because age very often determines the level of education reached, the life style behaviour of the mother, attitudes towards pregnancy and the psychological maturity reached. Age on the other hand is regarded as a biological variable because it determines a woman's physiological and reproductive efficiency. Maternal age was defined as age completed years during pregnancy and was categorised into less than 30 years and 30 years or more years. The results of this analysis showed that women who were in the age group, 30 years and over, had a significant risk for perinatal and neonatal mortality while women who were less
than 30 years of age were not at risk. On further analysing maternal age into smaller age groups (<20, 20-24, 25-29, 30 to 34, and 35+ years) and taking the reference group to be 25 to 29 year of age it was shown that a significant difference can again be demonstrated (perinatal and neonatal deaths increases with increasing maternal age). Women more than 30 years of age were at a significant risk of perinatal mortality. Probably the significant levels reached in women of more than 30 years could have been explained by age related medical conditions especially diabetes, hypertention, increasing parity, and prior reproductive problems these factors were not standardised in this study. However the results reached in this study were in agreement with another previous local study carried out by Savona-Ventura and Grech 1987. Past researchers have reported on similar findings; Butler and Bonham 1963, Chamberlain et al 1975, Aldous and Edmonson 1993 However recent studies however have found little or no association between maternal age and adverse pregnancy outcomes Fretts and Usher 1997.

Women below 20 years of age were not found to be at risk of adverse outcomes in this analysis probably because they were grouped all together, this may have hidden significant younger age differences. However because of the small numbers of young teenagers, it was impossible to make a more detail grouping. A previous local study carried out by Savona Ventura and Grech 1987, showed that teenagers less than 17 years of age were at a greater risk of perinatal and neonatal mortality due to prematurity. Similar association were found in other studies: Butler and Alberman 1969, Elster et al 1984, Satin et all 1994.
In the future obstetricians and general practitioners must council women in their 30s and 40s about the risk of childbearing as the trend today is to postpone childbearing until careers are well established. This behaviour is further augmented by the increasing opportunity provided by assisted reproductive technology to allow women to consider pregnancy at advanced ages. These attitudes towards childbearing may increase perinatal and neonatal mortality incidence in the future years. Therefore knowledge of the effects of advanced maternal age are important in guiding decisions for future obstetric and maternity care.

**Paternal occupation**

Occupation of father was taken as a socio-economic measure as there are no formal social class indicators available from current and past demographic data on these islands. Occupational class in this study was not found to be predictive of adverse pregnancy outcome. This result was obtained probably because of the small numbers available. However on comparing the proportion of occupational classes in the two groups, it was found that there was almost an equal distribution of all class between the deaths and live births. On looking to the media and departmental publication it is known that in 1993 to 1995 unemployment rates were less than 3 percent, absolute poverty is non existent. Also a large proportion of the employed workforce on these islands have more than one source of income, there are no homeless people on these islands. Less fortunate mothers and their babies on these islands are cared for my the catholic religious organisations. The state compensate for disadvantaged social circumstances of pregnancy by allowing maternity leave on full pay and family allowance for all unpaid work. However previous studies on social class have shown some
controversial results with past studies showing that socioeconomic status plays a
major role in adverse pregnancy outcome (Butler and Bonham 1963, Butler and
Alberman 1969, Chamberlain et al 1973) while more recent research questions
whether this is so (Baird 1980, Peacock, Bland and Anderson 1995, Wildschut et
al 1997).

Future studies on perinatal mortality should investigate the effects of women in
employment as they have joined the work force in substantial numbers and also
investigate the effects of pregnant mothers in employment at various industrial
locations, especially in the first 4 months of pregnancy.

**Maternal smoking**

The effects of cigarette smoking was not found to be associated with adverse
pregnancy outcomes in this study probably because of the large amount of
missing data. In other published research smoking however has been correlated
with increased perinatal mortality Butler and Alberman 1969, Butler and Golstein
et al 1972, while recent studies have shown smoking to be associated with small
for date babies rather than directly related to these mortalities Cardozo et al
smoking was related to a two fold increase of preterm delivery before 32 weeks
and had no effect on delivery after 32 weeks.
In the light of this it is important that the MIS records be complete and accurate, so that future studies will be able to assess the effects of smoking on the outcomes of pregnancy.

**Body Mass Index**

On analysing body mass index for the cases and controls and taking BMI of 20 to 24 as the reference group (Garrow in Bellizzi et al; 1981), no statistical significance difference was found between the births and deaths. A non statistical significance implies that in this study overweight and obesity does not have a bearing on outcome of pregnancy. These results however must be considered within the limitations of this study.

**Parity**

Parity was studied by dividing, cases into three groups: mothers having their first baby, those with 1 or 2 babies and those with 3 or more babies. On analysing the data using mothers with 1 or 2 babies as the reference group, a significant difference was almost seen with regards to primipara having an adverse outcome in their pregnancy since the OR was 1.44 and the confidence interval was 0.98 to 2.12. Similarly those who were having their third or more baby did not show a significant difference with regards to the outcome of pregnancy, possibly because they were grouped all together, which may have hidden significant differences. However because of the small numbers in the para 3+ group, it was not feasible to disaggregate further. Although there was a difference in rates between the para 0 and para 3+ mothers, this just missed the 5% significance level.
Gestational age at delivery

In this study births and deaths were categorised into two groups, those occurring before 37 completed weeks of gestation and those occurring at 37 weeks or after. It was found that perinatal and neonatal deaths were greater (76% of all deaths) in deaths before 37 weeks of gestation when compared to deaths equal to or after 37 weeks (24%). There was a significant difference in stillbirths and neonatal deaths between the two groups giving an OR of 18.0 and confidence interval of 11.2 to 29.0. On further analysing gestational age and dividing into small groups, as shown in the results section of this study, a significant difference can again be demonstrated. However other variables like maternal age, social class, smoking, parity and birthweight were not standardised in this analysis and may have provided an alternative explanation for this association. Occupational class, marital status and smoking were not found to be significant risk factors in this study.
Birth weight

Birth weight was categorised, according to ICD-9 Classification of diseases, injury and cause of death, into those deaths and births below 2500g and those equal to or above 2500 g. On analysing the two categories of birthweight and the outcome of pregnancy, it was found that there was a gross difference in the distribution of birth weight in babies who died and those who survived. Those who died were predominantly less than 2500 g in birth weight whilst those who survived were equal to or more than 2500 grams. The strong statistical significance reached confirms that in Malta birthweight is a major factor in influencing the outcome of pregnancy. The high mortality of low-birthweight babies may be associated with intrauterine infections, multiple pregnancies, poor placental function due to maternal illness Other fetal conditions that may be implicated in the survival of low birthweight babies are hypothermia, symptomatic hypoglycaemia and poor lung function. At all birthweights fatal congenital abnormalities incompatible with life may play a role. In fact on further grouping birth weight in smaller categories (very low birth weight (<1500g), low birth weight (1500-2499g) and birth weight more than 2500g) it was found that in deaths less than 1500 grams, 50 % of deaths were due to conditions originating in the perinatal period while 12 % of causes were attributed to congenital abnormality. On the other hand in the deaths of more than 2500 grams, 51 % of were attributed to congenital abnormalities, while 27 % was attributed due to conditions originating in the perinatal period. These findings should be considered within the limitations of this study as other associated variables (age, smoking, social class, gestational age) were not standardised in this analysis. These factors may have provided an
alternative explanation for association between birth weight and adverse outcome.

Past researchers have shown that gestational age and birth weight have a significant effect on perinatal and neonatal mortality, after standardising for other associated variables (Butler and Alberman 1963, Butler, Goldstein et al 1972), English et al 1992 showed that smoking was related to low birth weight and preterm births. Aldous and Edmonson 1993 showed that maternal age (40+yrs) was associated with low birth weight after adjusting for a number of variables, including smoking, socio-economic, medical complications and the route of delivery.

However much of the reduction of perinatal and neonatal mortality that has taken place in the last 10 years has been attributed to increasing the survival of low birth weight babies and not in preventing it (WHO 1985).

**Infant gender**

Among the causes of perinatal and neonatal mortality inherent in the fetus, gender plays a poorly understood role. Male infants are known to have a higher death rate than female infants, an observation reported by Butler and Bonham (1963) and Butler and Alberman (1969). In this study there was no significant difference between infant gender and adverse pregnancy outcomes; the proportions of males and females were equally distributed between the deaths and births. This implies that gestational age at delivery along with birth weight play a role in these mortalities greater than the gender of the infant.
Locality of residence

Locality of residence was investigated in this study as a potential social indicator of perinatal and neonatal mortality. Malta is divided by the Central Office of Statistics into five geographical regions; each region comprises of smaller towns and districts. There are no clear demarcations of commercial, industrial, residential or agricultural areas within the different regions. In this study no significant regional distribution of perinatal mortality was found, although the numbers varied within regions. This may have been due to the nature of the grouping of towns and districts into regions, which may have obliterated significant geographic differences. There were not enough data available to study intraregional differences. There are no obvious health advantages of one region over the other. Expert medical and midwifery care, maternity services in the public and private sectors are equitably distributed throughout the island, which objectively speaking is a small size. Regional variations in perinatal and neonatal mortality have been observed elsewhere (Butler and Bonham 1963, Butler and Alberman 1969)

Certified causes of fetal and neonatal death

Causes of perinatal and neonatal mortality are often multifactorial with interaction between conditions affecting the mother and those affecting the fetus, thus making it difficult to prioritise cause of death. However all certified causes in this study have been grouped under certain broad headings as proposed by ICD-10 and the data have been analysed according to cause.
From the results it is evident that in deaths with a birth weight of 1500 grams or more, most of the perinatal and neonatal mortality is due to congenital malformations, deformations and chromosomal abnormalities (Q00-Q99, ICD-10). In this group, 36 percent were in stillbirths while 64 percent were attributed to deaths in the neonatal period. When looking at these causes according to gestation at delivery, 47% occurred at a gestational age of more than 37 weeks.

A past local study carried out by Sultana and Calleja (1967) showed that the commonest cause of perinatal death was intrapartum anoxia with congenital malformations as the second commonest cause. These results show the increasing proportion of death due to congenital and chromosomal disorders today. These causes, which are incompatible with life, are an unavoidable cause of perinatal deaths in birth weight of more than 1500g, that cannot be reduced by improved obstetric care, unlike intrapartum anoxia. Women today are more in the work force so the effects of chemical and physical hazards during the first trimester of pregnancy may need to be evaluated as well. The increasing maternal age at first delivery is another contributing factor.

Most deaths in babies with a birth weight below 1500g were attributed to other causes originating in the perinatal period (P00-P99). In this group 32% of causes of P00-P99 certified were attributed to "intrauterine or stillbirth deaths cause not specified" (P95), of which 79% were in antepartum stillbirths, 13% were in intrapartum stillbirths and 7% were in stillbirths, not known whether antepartum or intrapartum. It was difficult to relate cause P95 to gestational age.
is the time of these deaths are not always known. A delay in delivery means that the stillbirth delivered at a particular gestational age include infants who died in utero at an earlier gestational age. This bias is difficult to measure; it probably affects preterm births more than post term births. These results highlight the importance of regular perinatal meetings in order to ascertain causes of perinatal mortality to take measures to reduce the avoidable mortality.

The low cause of death due to maternal complications may be attributed to the high level of obstetric care that has been established in the Maltese islands during the past two decades.

**Conclusion and Recommendations**

Every new birth is an absolutely unique event. Any birth, even the most thoroughly planned, has an unpredictable element even in a population which is generally healthy. This was evident in this study which addressed the biological as well as the social aspects of live births and perinatal/neonatal deaths. The results obtained in this study show that perinatal and neonatal deaths in the Maltese Islands were associated with advanced maternal age, low birth weight (<2500g), and preterm births (<37 weeks). However the reasons why labour is initiated either early, late or on time is largely unknown. On looking into the causes of fetal and neonatal death, it was seen that in low-birthweight outcomes, congenital abnormalities, deformations and chromosomal disorders were responsible. On the other hand in very low-birthweight deaths, conditions
pertaining to the perinatal period were implicated. These findings have been in agreement with much of the literature on this subject today. However the findings in this study show that it is essential to have large datasets in order to show the effects of some of the variables. Also, the lack of standardisation and the absence of direct indicators interfere with the full interpretation of these factors in this study. Some variables that are well known to be associated with these mortalities have not been correlated in this study largely because of the lack of large number of records necessary to eliminate the effects of many confounding variables which are strongly interrelated.

Much of the reduction in neonatal mortality has been attributed to the systems of care on this island. The Special Care Baby Unit at Karin Grech Hospital has been instrumental in preventing an increase in the number of deaths during the neonatal period. However the future may see more babies being born at shorter gestational ages especially in muti-fetal pregnancies and at very low birth weights. More babies may be transferred from the womb to the Special Care Baby Unit at low-birthweights and at an earlier gestation. Yet the only tangible link between the obstetrics and paediatric departments is often the partogram. Undoubtedly the partogram has great potential to alert professionals on the progress of labour and fetal and maternal distress. However professionals tend to view pregnancy, birth, and the period after birth as three separate clinical entities, requiring different clinical settings. This along with several other factors highlights the importance of pooling specialised knowledge of obstetrics, paediatric and possibly anaesthesiology together in order to manage the period.
around birth. This highlights the important role that a perinatology unit involving both the departments of obstetrics and paediatrics could play so as to increase birthweight-specific survival, so as to prevent deaths in babies born too early and too small.

Future studies could focus on behavioural factors such as substance abuse, the effects of physical and chemical agents in pregnant women who are employed at many small-scale industrial sites, along with smoking habits. These are needed to provide a better understanding of the causes of increased low birth weight and preterm delivery.

Birth is the culmination of pregnancy, a special time both emotionally and physically for each woman and should be a joyous event with the delivery of a live born infant to a healthy woman. Reduction in perinatal and neonatal deaths should not only be a considered a socio-economic achievement but also an achievement at the human and personal level.
References


Bellizzi M, Gauden G, Aguis Muscat H. 1992; Food and Health in Malta, Malta.


Demographic Review of the Maltese Islands. 1995; Central Office of Statistics, Malta.


Annex 1

Maternity Information System

S.L.H. Data

Delivery Number

Department of Health Information

Department of Obstetrics & Gynaecology

DHI - M(1)
DH 867
<table>
<thead>
<tr>
<th>SLH DELIVERY NO</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

(BOOKING – contd)

Date of booking

Consultant in charge at time of booking (Med Reg no)

Weight at time of booking (kg)

Height (cm)

Present Smoking Habit

0: Never smoked, 1: Stopped, 2: Occasional, 3: Mild, 1-10/day, 4: Moderate, 11-20/day, 5: Heavy, over 20/day, 6: Non-smoker (not known if 0 or 1), 7: Smokes (number unknown), 9: Not known

Last Menstrual Period

Certainty of LMP  
1: Certain, 2: Uncertain, 9: Not known

Regularity of cycle  
1: Regular, 2: Irregular, 9: Not known

Expected date of delivery (from blue card)

Past Obstetric History

Number of babies born alive

Number of babies born alive but died before 28 days

Number of babies born dead (b.w. 500g+, or at 22+ wks gestation)

Number of miscarriages (b.w. under 500g and below 22 wks gestation)

Number of Caesarian sections

Bleeding before booking  
0: No, 1: Spotting only, 2: Yes, 9: Not known
### Analgesia (pain relief) during labour or delivery

(0: No analgesia, 1: Self-administered inhalation, 2: Narcotics, 3: 1 and 2, 4: Epidural/other analgesia)

<table>
<thead>
<tr>
<th>Duration of labour</th>
<th>Stage I</th>
<th></th>
<th>hrs</th>
<th>mins</th>
<th>Stage II</th>
<th></th>
<th>hrs</th>
<th>mins</th>
<th>Stage III</th>
<th></th>
<th>hrs</th>
<th>mins</th>
</tr>
</thead>
</table>

Episiotomy (0: No, 1: Yes, 9: Not known)

Perineal tear (0: None, 1: 1st or 2nd degree, 2: 3rd degree, 9: Not known)

Other damage to vagina (0: No, 1: Yes, 9: Not known)

Damage to cervix (0: No, 1: Yes, 9: Not known)

Damage to uterus (0: No, 1: Yes, 9: Not known)

Damage to bladder (0: No, 1: Yes, 9: Not known)

Postpartum haemorrhage (0: No, 1: Yes, 9: Not known)

Retained placenta/products (0: No, 1: Yes, 9: Not known)
Foetal distress (code the worst)
(0: None, 1: Meconium liquor, 2: Abnormalities of foetal heart, 3: Abnormality of scalp pH, 4: Antepartum death, 5: Not known)

Resuscitation – Ventilation (0: None, 1: Mask, 2: Intubation, 9: Not known)

Resuscitation – Drugs (including bicarbonate) (0: Nil, 1: Given, 9: Not known)

Congenital abnormalities (0: Nil, 1: Single, 2: Multiple, 9: Not known)

Birth trauma (0: No, 1: Yes, 9: Not known)

Cord prolapse (0: No, 1: Yes, 9: Not known)

No of vessels in umbilical cord (Usually: 3, rarely: 2, not known: 9)

Head circumference (at birth in cms)

INFANT DISCHARGE

Date of infant’s discharge

Method of infant’s discharge
(1: Home, 2: Other health institution, 3: Dead, 4: still in hospital after 28 days, 5: Creche, 9: Not known)

Feeding method at time of discharge
(1: Breast, 2: Bottle only, 3: Mixed breast and bottle, 7: Died, 8: Other, 9: Not known)

Weight on discharge (grams)

Diagnoses/conditions on discharge (if any, write one per line)
Annex 2

Definitions

A stillbirth is defined as any fetus born dead with a birthweight of 500 grams or more, and from the 22nd week of gestation onwards. A live birth refers to any baby irrespective of the duration of pregnancy, who after separation from its mother breathes or shows some evidence of life. Since the time it was recognized that potential causes of death of babies may operate during pregnancy and labour may project their ill-effects into the first few days of life, the concept of perinatal mortality, was introduced. Perinatal mortality includes stillbirths and deaths occurring in the first week of life (early neonatal deaths). The late neonatal deaths is defined as deaths occurring between the 8th to the 28th day after birth.
Annex 3

Localities included in each region

**Inner Harbour Region**
- Valletta
- Floriana
- Sliema
- Gżira/Ta'Xbiex
- Msida
- G'Mangia/Pieta
- Hamrun
- Marsa
- Paola
- Cospicua
- Senglea
- Vittoriosa
- Kalkara
- Sta. Lucia

**Outer Harbour Region**
- St. Julians
- San Gwann
- Birkirkara
- Sta. Venera
- Qormi
- Luqa
- Tarxien
- Fgura
- Zabbar

**South Eastern Region**
- Qrendi
- Mqabba
- Zurrieq
- Safi
- Kirkop
- Gudja
- Ghaxaq
- Birzebbbugia
- Marsaxlokk
- Zejtun
- Marsascala
Western Region
Dingli
Rabat
Mdina
Siggiewi
Zebbug
Attard
LiJa
Balzan

Northern Region
Mellieha
St. Paul's Bay
Mgarr
Mosta
Naxxar
Gharghur

Gozo & Comino
San Lawrenz
Gharb
Ghasri
Kercem
Munxar
Fontana
Victoria
Zebug
Xaghara
Xewkija
Sannat
Gh'Sielem & Comino
Nadur
Qala