

Reducing Perinatal and Infant Mortality in Walsall

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Foreword

About 3600 babies are born each year to mothers living in Walsall. More than 99% of these babies survive and live beyond their first year. Programmes and strategies have been implemented progressively over a number of years to improve maternity care in both hospital and community settings in Walsall and this has been reflected in a long term trend decline in perinatal and infant mortality rates.

This report, however, focuses on the small number of babies, an average of less than 50 per year, that are stillborn or die before their first birthday. Each of these deaths represents a personal tragedy to the families concerned.

Concern over the level of infant deaths in Walsall was heightened by evidence in the last few years that these deaths were increasing. Under the auspices of the Walsall Infant Mortality Steering Group, a major review has therefore been undertaken to examine the pattern of these deaths, with a view to identifying what more needs to be done to reduce perinatal and infant mortality in Walsall.

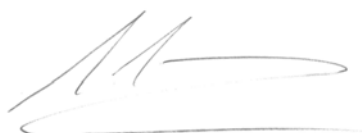
It is important to recognise that the report findings do not imply any criticism of the quality of care provided by Manor hospital or other maternity units used by Walsall mothers. Smoking in pregnancy, socio-economic deprivation, consanguineous marriages and obesity are all identified in the review as key factors resulting in a much higher risk of mothers in Walsall experiencing a stillbirth or infant death. These local findings are consistent with much research evidence conducted elsewhere in the UK and more widely. Moreover, it is clear that preventing infant mortality is a task not just for health professionals but also for individuals, families, communities and their leaders, as well as organisations concerned with providing services to ensure economic and social wellbeing.

A number of population based and service development recommendations are made in the report to reduce infant deaths in Walsall. We are confident that, working together with the community, a substantial reduction can be achieved.

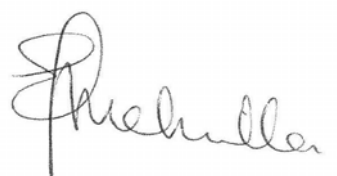
Our thanks go to Rachel Robinson and Graham Fee, who prepared the report, and to all our colleagues listed in section 5 who contributed to the data collection and analysis.



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1. Executive Summary and Recommendations for Reducing Perinatal and Infant Mortality in Walsall

1.1 Executive Summary

The summary below highlights the key findings of the Walsall review. Where appropriate, reference is also made for comparison purposes to research findings of other regional/national or international research projects on infant mortality, identified in the Literature Review (Appendix 2).

- Two pro-formas were developed to collect relevant information from patient notes. Mothers and babies were identified from death files and hospital databases covering the period 2001-2006. Almost 80% of the notes were located and reviewed and of these it was possible to complete the pro-formas in 86% of the cases. This resulted in a total of 223 cases from 8 hospitals in the region serving Walsall mothers. However, as Walsall Manor Hospital is the main provider of maternity services for Walsall residents and the number of deaths at each of the other seven hospitals individually were relatively small, this report focuses particularly on the 161 deaths at Manor Hospital for which a pro-forma could be completed.
- The 161 stillbirth and infant deaths at Manor Hospital between 2001-2006 in the review are summarised below.

Table 1 Stillbirths and Infant Deaths at Manor Hospital 2001-2006

	Number	%
Stillbirths (24 wks to birth)	74	46.0
Early Neonatal (<7 days)	56	34.8
Late Neonatal (7 to 28 days)	5	3.1
Post Neonatal (29 days to 1 year)	23	14.3
Not Known	3	1.9

Key Message

Over 80% of the deaths were either stillbirths or deaths within 7 days of birth.

This is consistent with other research findings¹

Ethnicity and Religion

- 60% of the total number of deaths were babies of White mothers but the death rate (per 1,000 births) of babies born to Pakistani women (15.3) was twice that of White women (7.7). Death rates among babies of other ethnic minority groups (except Indian) were also higher than for White babies but, due to small numbers, the differences were not statistically significant.
- Other researchers have also found higher infant death rates among BME groups than among White mothers in the West Midlands, although the excess Pakistani death rates were not as great as in Walsall¹
- Consistent with the findings in relation to ethnicity, the risk of stillbirth and infant death among Muslim mothers in Walsall was twice as high as in other mothers.
- There were 24 deaths of babies born to parents in a consanguineous marriage. The risk of stillbirth and infant death of babies where parents were in a consanguineous marriage in Walsall was three times higher than for parents in a non-consanguineous marriage. 23 of the 24 deaths were babies born to Muslims.

A recent research study in Bradford also found strong links between infant deaths and consanguinity⁶.

Key message

Muslim women in consanguineous marriages are at much greater risk of their baby dying compared to other groups: women in consanguineous marriages are over three times more likely to suffer a stillbirth or infant death.

Reducing the number of consanguineous marriages entered into will reduce stillbirths and infant deaths among Muslim women in Walsall.

Smoking in Pregnancy

- There were 55 deaths of babies where the mother smoked during the pregnancy, of which 48 were babies of White mothers. The risk of stillbirth and infant death of babies born to White mothers who smoked during pregnancy was almost 3 times higher than for those who did not smoke in pregnancy.

The link between smoking in pregnancy and higher risk of infant deaths is well established in several other research projects.^{2,3,4,5,6,7,9}

Key Message

Smoking in pregnancy is a major cause of preventable stillbirths and infant deaths. If a mother smokes in pregnancy, the odds of the baby dying are almost three times higher than if she did not smoke.

Reducing the number of women who smoke during their pregnancy will make a significant contribution to reducing stillbirths and infant deaths in Walsall.

Socio-economic Deprivation

- Almost three quarters of the deaths (total 119 deaths) were babies of parents in the two most deprived quintiles of socio-economic classification. The risk of stillbirth and infant death in the most deprived socio-economic quintile in Walsall was over 80% higher than for babies born to parents in the least deprived socio-economic group. The link with deprivation is also reflected in the geographic distribution of the death rates across the 20 Walsall wards.

Other recent research projects, notably a study by the West Midlands Perinatal Institute,¹ have also established similar strong links between infant deaths and parental deprivation.

Age of Mother

- The average age of the mothers suffering a stillbirth or infant death in Walsall was 27.6 years and almost 84% were between the age of 20-40 years. There is some suggestion of increased risk of stillbirth or infant death among older "professional" mothers but small numbers mean that this is not statistically significant.

Other research suggests that younger mothers (under 20) and older mothers (40+) have a higher risk of an infant death.^{1,2,3,4,5,6,7} This was also the situation in Walsall for younger mothers but older mothers in Walsall had a lower risk (15% of births but less than 4% infant deaths). The latter may be related to the very

low smoking prevalence and lower deprivation among these Walsall older mothers.

- Gestational age at delivery averaged 31.4 weeks (range 19-41 weeks). 18 deaths (11%) were of babies under 24 weeks gestation, and almost 45% of these were born to mothers in the most deprived socio-economic group. However, half of the deaths were of babies over 24 weeks gestation with no congenital problems. For these deaths there was again a strong association with deprivation: for example only 1% of deaths were babies of mothers in the least deprived group whereas 55% of deaths over 24 weeks gestation were in the most deprived socio-economic group.

Low Birth Weight

- Two thirds of the Walsall stillbirths and almost 10% of live births who subsequently died were babies whose birth weight was under 2500gm.

The link between birth weight and a baby's chance of survival is documented in several research reports.^{2,3,4,5,6,7,9,11}

Key message

Tackling socio-economic deprivation across Walsall's communities will reduce stillbirths and infant deaths.

Targeting resources at the high risk population groups will have a key role in this.

Body Mass Index (BMI)

- BMI had been recorded for only 41% of mothers in the review, as comprehensive data collection for BMI only started at Manor Hospital in 2006. Among the group whose BMI had been recorded, over 30% of deaths were babies of mothers with a BMI over 30. The Walsall review suggests that the risk of stillbirths and infant deaths may be 30% higher in mothers with a BMI over 30, although this estimate is not statistically significant due to small numbers in the sample.

Other recent research studies, notably by the West Midlands Perinatal Institute, suggest that women with a BMI over 30 are at higher risk of having a baby who will die within 1 year (Odds ratio 1.44 for women with a BMI of 30-34.9).¹ Local and national evidence also supports this.

Key message

Women with a high BMI are at higher risk of their baby dying.

Healthy lifestyle and healthy weight needs to be encouraged before pregnancy, as part of the overall strategy to tackle obesity in Walsall.

Recording BMI of all antenatal service users needs to be maintained.

Congenital Abnormalities

- 39 of the 161 deaths at Manor Hospital (24%) were of babies with a congenital abnormality.
- Over one third of these deaths were of babies born to Muslim mothers, who had more than a three fold greater risk than compared to other groups with a congenitally abnormal infant death. (Odds ratio 3.28, confidence interval 1.53-7.06).
- Consanguineous marriage was again an important factor associated with these deaths: 10 of the 39 deaths of congenitally abnormal babies were to mothers in consanguineous marriages, and these mothers had almost twice the risk of a congenitally abnormal baby death than other mothers (Odds ratio 1.97, confidence interval 0.85-4.56).

Stillbirths/Neonatal and Infant Deaths

- Analysis of the 74 stillbirths in the review indicated two groups of babies – those very small and born early, and those born over 37 to 38 weeks gestation.
 - As in the overall review, many of the stillbirths were characterised by mothers who smoked in pregnancy, socio-economic deprivation, consanguineous marriages and, where recorded, a high BMI.
 - 30 stillbirths (40% of stillbirths) were of small babies under the 10th weight centile, including 17 babies under the 2nd weight centile. 28% had a birth weight of under 1000gm.
 - The average age of the mothers experiencing a stillbirth (28.4yrs, range 16-44 yrs) was similar to the average for all Walsall births (27.6yrs).
- Of the 56 babies that died at Manor Hospital before they were 7 days old (early neonatal deaths), 70% (40) were less than 1 day old. Prematurity and congenital abnormalities were the main causes of death listed. The classification of stillbirths and early neonatal deaths is currently being reviewed.
- 23 babies died at Manor Hospital between one month and one year old (post neonatal), all of whom were 25 weeks or over gestational age at delivery. Over 40% of these (10 babies) were born with a congenital problem. Among the infants without a congenital problem, there were a small number of cases of Sudden Infant Death Syndrome and in these cases each of the mothers were in the two most deprived socio-economic quintiles.

Key message

Separate sub-group analysis for stillbirths and infant deaths confirm previously highlighted links with smoking in pregnancy, ethnicity, consanguineous marriage, socio-economic deprivation and high BMI.

Saving Lives by Removing Excess Risk

The excess risk analysis relating to factors associated with the 161 stillbirths and infant deaths at Manor Hospital suggests that addressing lifestyle, cultural and socio-economic factors could prevent half or more of these deaths:

- ❖ If all pregnant women in Walsall did not smoke, 37 stillbirths and infant deaths could have been prevented (range 29-41). This is equivalent to 23% of all the deaths, predominantly among White mothers.
- ❖ Not entering into consanguineous marriages could have prevented 18 stillbirths and infant deaths (range 14-21), predominantly in the Muslim community. This is equivalent to 11% of all the deaths.
- ❖ If all women maintained a healthy weight before and during pregnancy, up to 29 stillbirths and infant deaths may have been prevented. This is equivalent to 18% of all the deaths.
- ❖ If people in the most deprived socio-economic group (quintile 1) were lifted out of deprivation, 56 stillbirths and infant deaths could have been prevented (range 49-61). This is equivalent to 35% of all the deaths.

Smoking and consanguinity affect mainly different population groups but deprivation and high BMI may impinge to some degree across all groups. The estimates are therefore not crudely additive. Nevertheless, a minimum of 34% and possibly over 50% of the deaths may have been preventable by elimination of all these excess risks.

Appendix 2 summarises the calculation of the number of potential preventable deaths by addressing these issues.

1.2 Recommendations for Reducing Perinatal and Infant Mortality in Walsall

1.2.1 Public Health Recommendations

The review has highlighted strong links between socio-economic, lifestyle/cultural issues and stillbirths and infant deaths in Walsall. These links are consistent with other independent research on stillbirths and infant deaths outside Walsall. There is therefore an opportunity to reduce infant deaths in Walsall substantially by addressing these issues. Based on these findings, population based public health recommendations are listed below.

- Intensify the targeting of antenatal health care resources on mothers in deprived socio-economic groups, to whom 3 out of 4 of the stillbirth and infant deaths occur in Walsall.
- Intensify targeted efforts to encourage and support women to stop smoking, preferably before they become pregnant, or at the earliest point in their pregnancy. Smoking prevalence is much higher among White mothers than among BME groups (although the latter may be under recorded due to cultural issues). The focus in this area should therefore be principally on White mothers, for whom the risk of stillbirth and infant death is almost 3 times higher among smokers than non-smokers.
- The excess stillbirth and infant death rates among Muslim women in Walsall (including particularly women of Pakistani origin) needs to be addressed partly through the targeting of deprived socio-economic groups as indicated above.

In addition, the stillbirth and infant death implications of consanguineous marriages among the Muslim community need to be addressed. The community needs to be made more aware of and understand that there is a 3 times higher risk of suffering a stillbirth or infant death if parents are blood related. Support should be sought from the whole of the Muslim community to discourage entry into consanguineous marriages, without stigmatising those couples already in this situation.

- Ensure that encouraging healthy lifestyle and healthy weight before pregnancy is an integral part of the strategy for tackling rising obesity levels across communities in Walsall.
- Work needs to be undertaken to evaluate the evidence base, in particular learning from other districts, to determine the most effective public health interventions to reduce stillbirths and infant deaths in diverse communities. Existing and new interventions in Walsall should be developed and modified as necessary to reflect best practice.
- Close monitoring of stillbirths and infant deaths needs to be continued, including the outcomes of local interventions to target groups at risk. This requires improved data capture for key areas identified in the study including consanguinity/ethnicity/religion, smoking and BMI.
- Through the Steering Group, ensure that the PCT, Hospital Trust and Local Authority continue to work together to address infant mortality. In particular, raising awareness and promoting initiatives locally to address the wider risk factors, including overcrowding and child poverty.

1.2.2 Service Development Recommendations

- This report is the product of a lengthy and extensive retrospective review of available data on perinatal and infant mortality in Walsall. However, timely good quality data is essential for driving forward plans to reduce infant mortality. It is therefore recommended that a new and improved electronic maternity data collection system is implemented at Manor Hospital, so that more precise and comprehensive data is available to help facilitate timely interventions and to monitor the effectiveness of interventions on specific "at risk" sub-groups.
- Increase ultrasound scanning frequency for "at risk" women. This would link with West Midlands Perinatal Institute work recommending scanning every two weeks from 28 weeks gestation for women at high risk of stillbirth or infant death. In Walsall this would require up to an estimated 6000 scans per year.
- Audit midwife staffing levels and follow up as necessary to ensure appropriate standards are always met.
- Continued training of midwives in the use of nicotine monitoring.
- Establish a joint commitment by Walsall tPCT and Walsall Hospitals NHS Trust to eliminate smoking in pregnancy through targeting of the Walsall health trainer programme, Walsall Stop Smoking Service, and midwives.

1.3 Taking the Review Forward

The purpose of this review was not to produce a comprehensive action plan, but was undertaken to identify important research findings and local evidence around the pattern of these infant deaths locally, with a view to identifying what more needs to be done to reduce perinatal and infant mortality in Walsall. It is the intention that based on the findings and the recommendations from this review, a comprehensive action plan will be developed.

Implementation Plan for Reducing Health Inequalities in Infant Mortality

A Good Practice Guide

This key report, published by the Department of Health in December 2007, presents a good practice guide to help reduce health inequalities in infant mortality to achieve the 2010 PSA target. It focuses on the 43 areas in the UK with the highest infant mortality rates, of which Walsall is one.

Seven key areas are identified in the guidance:

1. Promoting joined up delivery of the target with maternity matters and Teenage Parents Next Steps. This includes improving access to maternity care;
2. Improving services for black and minority ethnic (BME) groups;
3. Encouraging ownership of the target through effective performance management;
4. Raising awareness of health inequalities in infant mortality and child health;
5. Gathering and recording routine data;
6. Undertaking joint needs assessments to identify local priorities;
7. Giving priority to evidence based interventions that will help ensure delivery of the target

Walsall has a large programme of work to address all of these areas, which is overseen by the Walsall Infant Mortality Steering Group.

This review project specifically helps to address items 4, 5, and 6 above, while supporting and making additional recommendations for the other key areas.

2. Introduction – The Population of Walsall

Map 1: Location of Walsall in the West Midlands



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Based on the 2001 Census, Walsall's population is about 253,000.

Approximately 50,500 of these are women of childbearing age (15-44yrs).

About 14% of the population (c34000) comprise ethnic minority groups, which have been the fastest growing population group in the borough. In some wards (such as Palfrey, Pleck and St Matthews) ethnic minorities comprise 38-48% of the ward population. Over 30% of all births in Walsall are to mothers from minority ethnic groups. These wards are amongst some of the most deprived in Walsall.

Socio-economic deprivation in some parts of Walsall is amongst the highest in England: 14 of the 169 most deprived areas in England are in Walsall; registered unemployment in Walsall (6%) in February 2007 was almost twice the West Midlands regional average (3.5%); in the 2001 Census, a higher proportion of the population in Walsall had no educational qualifications (43%) compared to the national average (29%), although performance of Walsall schools has improved in recent years.

Surveys of the local population (particularly the 2005 West Midlands Regional Lifestyle Survey) have indicated widespread and persisting unhealthy lifestyles among large sections of the Walsall population, as well as substantial variation across the borough:

- About 20% of Walsall adults smoke. 20% of women smoke in pregnancy, including 26% of White mothers. Also, 33% of pregnant teenagers smoke.
- Only about 20% of men and 28% of women in Walsall eat the recommended 'five-a-day' portions of fruit and vegetables.
- Almost two thirds of Walsall adults drink alcohol and of these about 23% of men and 10% of women in Walsall are drinking in excess of weekly 'sensible drinking' guidelines. In addition, about 38% of male drinkers and 21% of female drinkers in Walsall are "binge drinkers".
- Only 40% of men and 35% of women in Walsall undertake the recommended weekly level of moderate exercise.
- The 2005 survey suggested that 19% of Walsall adults were obese but more recent data from GP practice registers suggests obesity prevalence may be over 30% in Walsall adults. In addition, a recent height and weight survey of school children in Walsall suggests that about 15% of Walsall children are obese and 28% are overweight or obese.

3. Understanding Infant Mortality in Walsall and Background to the Review

Definitions of Key Terms	
Stillbirth	Death from 24 weeks gestation to birth.
Neonatal death Early neonatal death Late neonatal death	Death within 28 days of live birth Death within 7 days of live birth Death between 7-28 days of live birth
Post neonatal infant death	Death between 29 days and 1 year of live birth.
Perinatal death	Stillbirths and deaths up to 7 days.
Infant death	Deaths up to one year (excluding stillbirths).
Consanguinity	A situation in which a couple are blood relatives (share a common ancestor).
BMI (Body Mass Index)	A measure of body mass. A BMI of 25-29 is classified as overweight and 30 and over as obese.
Congenital abnormality	Any structural/biochemical abnormality present at birth.

From 2001-2006 the number of annual births to Walsall mothers fluctuated between about 3200 and 3600.

The Walsall birth rate among women aged 15-44yrs (71.9 in 2005) is higher than the national and West Midlands regional averages (62.2 and 60.4 respectively).

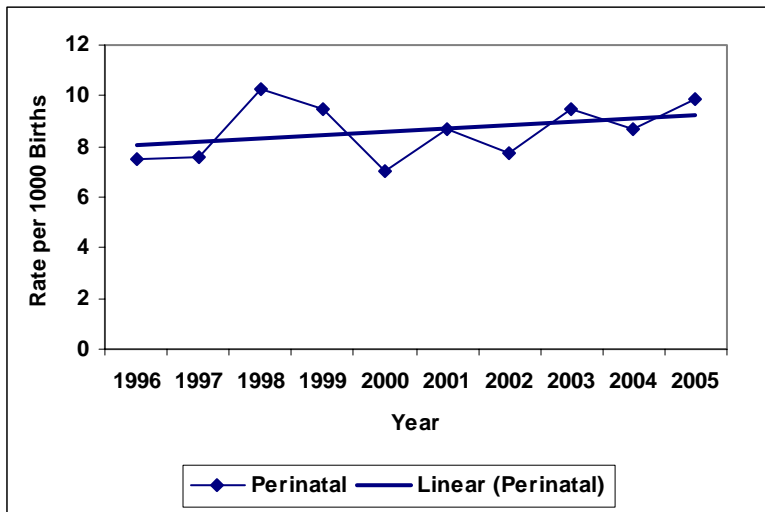
About 90% of the Walsall PCT births take place at Walsall Manor Hospital, with the remainder taking place mainly at New Cross Hospital Wolverhampton, Good Hope Hospital Sutton Coldfield, and Birmingham Women's Hospital. In 2006, about 32% of the births were to mothers from ethnic minority groups.

There are large variations in infant mortality by social class, ethnicity, age of mother and births outside of marriage. Reducing infant and perinatal mortality is therefore a key Government target in its programme for addressing health inequalities. By 2010, this target is to reduce by at least 10% the gap in (infant) mortality between manual groups and the population as a whole. To help facilitate delivery of the target, the Government made five recommendations in a Review of the Health Inequalities Infant Mortality Target (Jan 2007). These include development and promotion of action to deliver the target, "joined up" delivery of services to the target group, encouraging ownership through effective performance management, raising awareness of the target, and improving data quality and strengthening of the evidence base.

Against this background, data from the West Midlands Perinatal Institute indicated that infant, perinatal and neonatal mortality in Walsall had increased substantially in recent years, particularly since 2000-2002, and was higher than national and regional averages.

For example, infant mortality in Walsall had more than doubled from 4.6 per 1,000 live births in year 2000 to 10.6 in year 2005. (In 2005 there were 35 infant deaths and 15 stillbirths in Walsall.) Figures 1 and 2 show the fluctuating pattern and trend in perinatal and infant deaths over the decade from 1996-2005.

Figure 1: Perinatal Mortality Rates (deaths under 1 year per 1,000 live and stillbirths) in Walsall Residents, 1996-2005

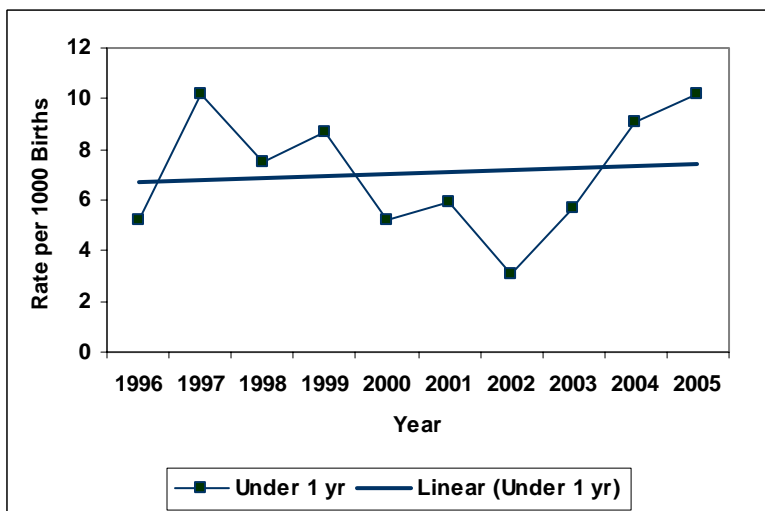


Source: Vital Statistics, ONS

There are marked year to year fluctuations in both perinatal and infant deaths in Walsall.

A trend increase is evident in both series, particularly from year 2000.

Figure 2: Infant Mortality Rates (deaths under 1 year per 1,000 live births) in Walsall Residents, 1996-2005



Source: Vital Statistics, ONS

Walsall Teaching Primary Care Trust and Walsall Hospitals Trust are committed to achieving the 2010 target. Understanding the changing patterns of infant and perinatal mortality and identifying the reasons for the recent increases in Walsall are crucial elements in addressing this commitment and is necessary to inform action plans to reduce the number of babies dying from preventable causes.

Walsall Infant Mortality Steering Group was established in 2006 to drive forward these issues. This comprises the following membership:

Walsall tPCT

- Paul Jennings, Chief Executive Walsall (Chairman)
- Dr Sam Ramaiah, Director of Public Health
- Sue Laverty, Consultant in Public Health Medicine
- Terry Mingay, Director of Community Services and Nursing
- Stella Forsdike, Director of Commissioning and Performance Management

Martin Turner, Head of Communications

Walsall Hospitals NHS Trust

Mike Browne, Medical Director

Elizabeth McMillan, Consultant in Obstetrics and Gynaecology

Gyanranjan Sinha, Consultant Paediatrician

Walsall Council

Pauline Pilkington, Assistant Director, Children's Services

Tim Challans, Assistant Director, Leisure, Culture and Lifelong Learning

This major review of the patterns and trends in infant and perinatal mortality in Walsall was therefore commissioned under the auspices of the Steering Group.

The stages of the review were:

1. Review the various sources of data on infant and perinatal mortality (e.g. frequency, data details, and uses of the data) with a view to understanding the variation in information and differences amongst sources.
2. Review infant deaths in Walsall since 2001, looking specifically at cause of death, ethnicity, low birth weight and age at death.
3. Undertake a detailed case note review (babies and mothers) of all Walsall babies who were stillborn or died within 1 year from 2001 to 2006.
4. Undertake a broad literature review on infant mortality patterns and causality. Key results from this literature review are summarised in Appendix 2.
5. Audit local work around actions to tackle infant and perinatal mortality.

This report summarises stages 2, 3 and 4.

The aims and objectives of the detailed case note review were to:

- Identify the modifiable and non modifiable factors affecting perinatal mortality and infant mortality rates.
- Make recommendations to form the basis of an Action Plan for reducing perinatal and infant mortality rates in Walsall.
- Create and maintain a database for ongoing monitoring of these mortality rates.

The CESDI register from Manor Hospital and Infant Death Register at Walsall PCT were used as the key data sources to identify cases to follow up in the detailed case note review. A total of 283 cases were initially identified for potential review.

Data Collection: Infant Deaths

Pro-formas were developed for both perinatal and infant deaths in order to collect relevant information for the review (appendix 3).

The perinatal mortality proforma included:

- Personal details
- Ethnic and religious background
- Economic background
- Medical and family history
- Social history – marital status, smoking, alcohol, substance abuse
- Past obstetric history
- Details of relevant pregnancy including – gestational age at booking, serum screening, anomaly scan, evidence of any complications during pregnancy and delivery.

The infant mortality proforma included:

- Medical history
- Development history
- Any congenital problems
- Immunisation
- Feeding problems
- History of foreign travel
- Any hospital admissions
- Social issues
- Accidents

As well as Manor Hospital, contact was made with other hospitals used by Walsall mothers, to obtain information on deaths of babies at these hospitals.

Of the 283 deaths identified from 2001-2006, 223 (79%) were reviewed, from which 86% of proformas were completed in full.

- Where medical notes were not reviewed this was due to a combination of reasons. These included storage issues leading to problems locating some of the notes. In addition, some inaccuracies and possible duplications on the hospital databases were identified, suggesting that the “total deaths identified” may actually be lower than recorded in Table 2. It is important to note therefore that the difference between ‘total deaths identified’ and ‘cases reviewed’ (283 out of 223) does not imply that the records of 60 deaths have been lost.
- Of those notes reviewed, the relevant pro-formas were able to be completed in 86% of cases. For some of the infant deaths, the mothers notes were available but the babies notes were not. In other cases the mothers notes were available at Manor Hospital but the babies notes were not available from the hospital to which the baby had been transferred.

Table 2: Data Collection Summary showing Numbers of Stillbirths and Infant Deaths in Walsall, 2001-2006

Place of Death	Total Deaths Identified	Cases Reviewed		
		Total	% Reviewed	% of reviewed that were complete
Manor Hospital	212	161	79	86
New Cross Hospital	20	18	90	93
Birmingham Children's Hospital	13	12	92	100
Birmingham Women's Hospital	7	7	100	86
Other Hospitals	12	1	8.3	100
Good Hope Hospital	5	5	100	100
Heartlands Hospital	4	3	75	0
Home and Dead on Arrival	10	10	100	100
Total	283	223	79	86

Of the 223 deaths initially reviewed, 7 were the result of miscarriage or termination of pregnancy and were therefore subsequently excluded from the study. Table 3 summarises the percentage break down of the residual 216 infant and perinatal deaths by place of death in comparison to the percentage of births in these locations.

Table 3: Data Collection Summary showing Percentage of Stillbirths and Infant Deaths in Walsall, by Infant Death Classification, 2001-2006

Place of Death	Births Total	Deaths				Total
		Stillbirth	Early Neonatal (0-6 days)	Late Neonatal (7-28 days)	Infant (28- 365 days)	
Manor Hospital	90.2	88.1	72.7	41.7	57.5	74.5
New Cross Hospital	3.1	4.8	10.4	25.0	7.5	8.3
Birmingham Children's Hospital	0.0	0.0	5.2	16.7	15.0	5.6
Birmingham Women's Hospital	0.5	1.2	6.5	0.0	2.5	3.2
Other Hospitals	2.0	0.0	1.3	0.0	0.0	0.5
Good Hope Hospital	3.2	3.6	1.3	0.0	0.0	1.9
Heartlands Hospital	0.0	0.0	2.6	8.3	0.0	1.4
Home and Dead on Arrival	0.9	2.4	0.0	8.3	32.5	7.4
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Almost 75% of the deaths occurred in Manor Hospital, which delivered over 90% of the births. In relation to the number of births, there were therefore fewer deaths at Manor Hospital (and at Good Hope Hospital) than at New Cross, Birmingham Women's and the Children's Hospital. In part this may reflect the transfer of some very sick babies to the specialist neonatal units of these hospitals. In addition, although home births accounted for less than 1% of all births, infant deaths at home or dead on arrival at hospital accounted for over 7% of all deaths, including over 30% of post neonatal deaths.

It is important to note that the data in Tables 2 and 3 cannot be used to compare the quality of care or outcomes in the different hospital units.

Data Collection: Births

Comparison information on births was obtained from two sources. Firstly, Manor Hospital information system provided information for total births, smoking, ethnicity and low birth-weight data. For other information not available via the hospital information system, an audit of bookings was carried out with community midwives. This included parameters such as religion, consanguinity and BMI.

4. Key Findings from the Review

4.1 Overall Findings

The overall findings from the review of all the stillbirths and infants deaths in the study are discussed in this section. As explained in section 3, births and deaths data and casenote information was reviewed for all the hospitals used by Walsall mothers. However, apart from Manor Hospital, the numbers involved at each of the other individual hospitals was relatively small and initial analysis suggested little difference in the (percentage) pattern of many of the outcomes between the total (all cases) and those of Manor Hospital alone. For example proportions relating to mothers who smoked, ethnicity patterns, consanguineous marriages, and deprivation were not significantly different between 'all cases' and Manor Hospital cases.

In this report therefore the focus is particularly on the deaths at Walsall Manor Hospital. On this basis, the overall findings are discussed in sections 4.1.1 to 4.1.6. Separate sections then summarise the findings relating specifically to stillbirths (section 4.2), early neonatal deaths (section 4.3) and infant deaths (section 4.4), again focusing on analysis of Manor Hospital cases.

4.1.1 Ethnicity, Religion and Consanguinity

60% of the stillbirths and infant deaths (97 deaths) were babies of White mothers and 35% were babies of Asian (45 deaths) and Black mothers (9 deaths).

Amongst the ethnic minority mothers, the highest number of stillbirths and infant deaths were babies of Pakistani mothers (28 deaths, 17% of total). However, this distribution needs to be considered in relation to the number of births among each ethnic group.

Figure 3: Stillbirths and Infant Deaths Rates per 1,000 births at Walsall Manor Hospital by Ethnicity, 2001 – 2006

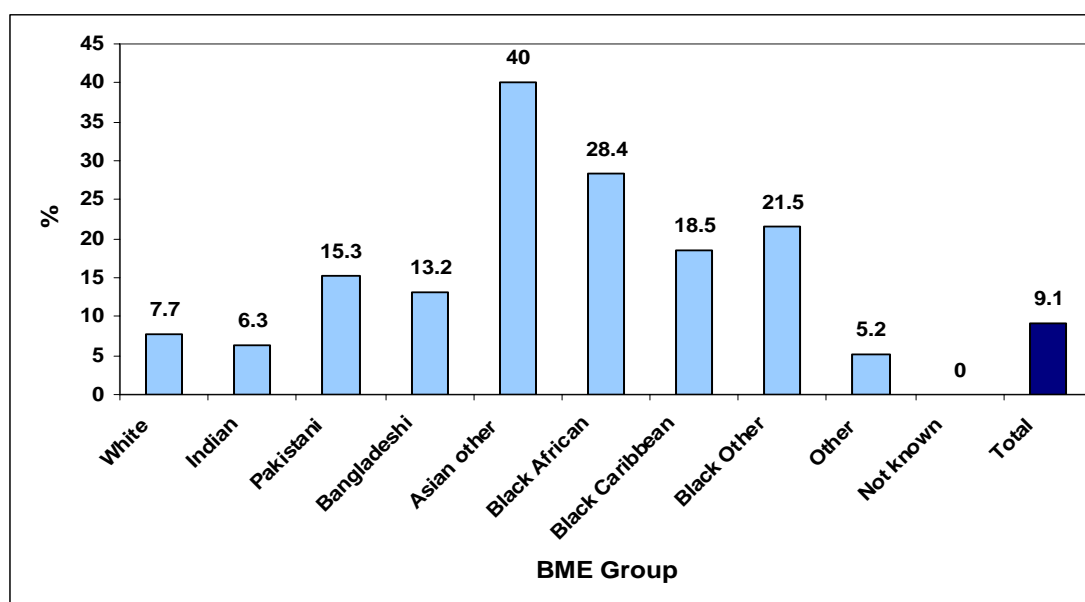
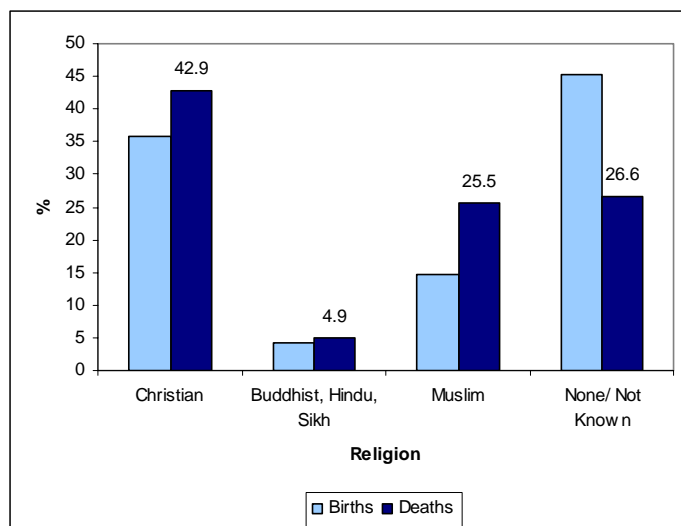


Figure 3 shows that the average rate of stillbirths and infant deaths over the period was 9.1 per 1,000 births. Except for Indian mothers and 'other or not known', the rate among Non-White mothers was much higher than among White mothers. *In most cases, these differences were not statistically significant* due to the low number of deaths in each group. For example 'Asian Other' comprised one death among 35 births and the death rate of 40 carries a confidence limit of -36.8 to 116.8.

However, the difference in the rate of stillbirths and infant deaths among Pakistani mothers (15.3) and White mothers (7.7) was statistically significant. **The risk of stillbirths and infant deaths in Pakistani women was double that of other groups** (odds ratio 2.0, CI 1.3-3.0 among Pakistani women, compared to an odds ratio of 0.7, CI 0.5-0.9 in White women).

Figure 4 shows the proportion of births and deaths in relation to the religious affiliation of the mothers.

Figure 4 : Percentage of Births, Stillbirths and Infant Deaths by Religious Affiliation in Walsall Manor Hospital, 2001-2006



Almost 15% of births were to Muslim mothers but over 25% of stillbirths and infant deaths were babies of Muslim mothers.

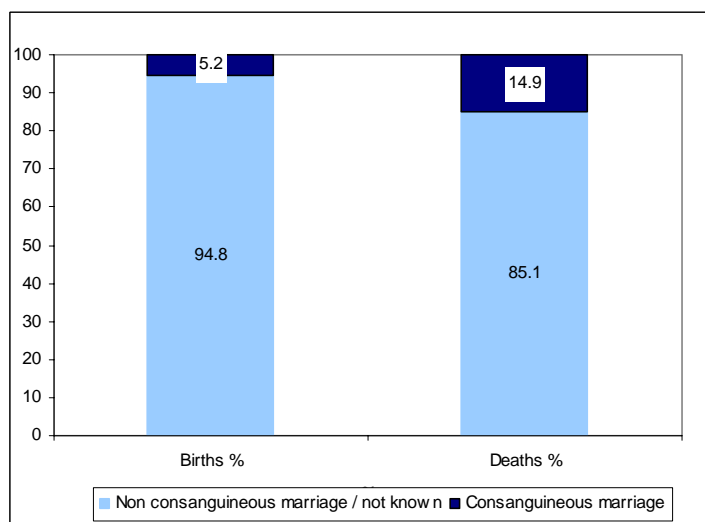
The risk of stillbirth and infant death in the Muslim population was twice as high as in the rest of the population.

(Odds ratio 1.98, confidence interval 1.30-3.03)

Consanguinity refers to a situation in which a couple are 'blood' relatives i.e. they share a common ancestor. An example is a couple who are first cousins. Consanguineous marriages are common among the Muslim community.

In the review, only 5% of all births were to parents in a consanguineous marriage but 15% of stillbirths and infant deaths were to parents in a consanguineous marriage. 23 of the 24 deaths of infants from consanguineous marriages had Muslim parents (20 of whom were Pakistani).

Figure 5: Percentage of Births, Stillbirths and Infant Deaths to Parents in Consanguineous Marriages, at Walsall Manor Hospital, 2001-2006



The risk of stillbirth and infant death in consanguineous marriages was over 3 times higher than in non-consanguineous marriages.

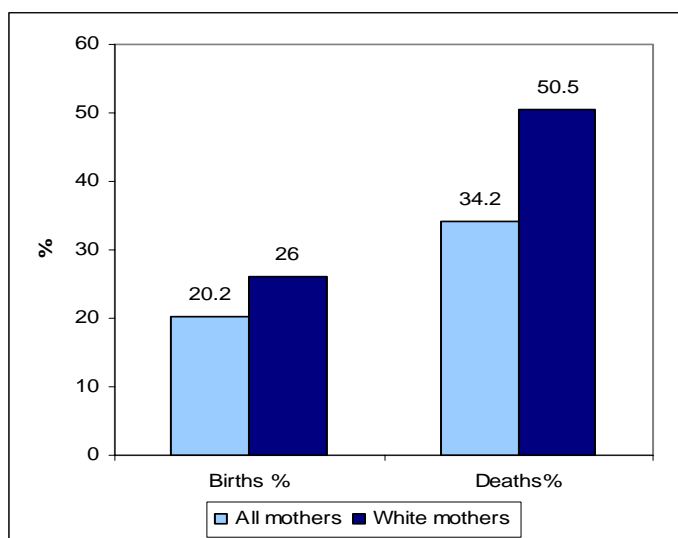
(Odds ratio 3.18, confidence interval 1.47-6.88)

4.1.2 Smoking in Pregnancy

Stillbirths and infant deaths were strongly associated with smoking in pregnancy: The review found that, whilst 20% of mothers smoked during their pregnancy, over 34% of the stillbirths and infant deaths were of babies of mothers who smoked.

Smoking is less prevalent among women from BME communities. Among White mothers 26% smoked during pregnancy, whilst over 50% of stillbirths and infant deaths among White women were to those who smoked during pregnancy. There were 55 deaths of babies whose mother smoked, including 48 babies of White mothers.

Figure 6: Percentage of Births, Stillbirths and Infant Deaths by Smoking in Pregnancy, at Walsall Manor Hospital, 2001-2006



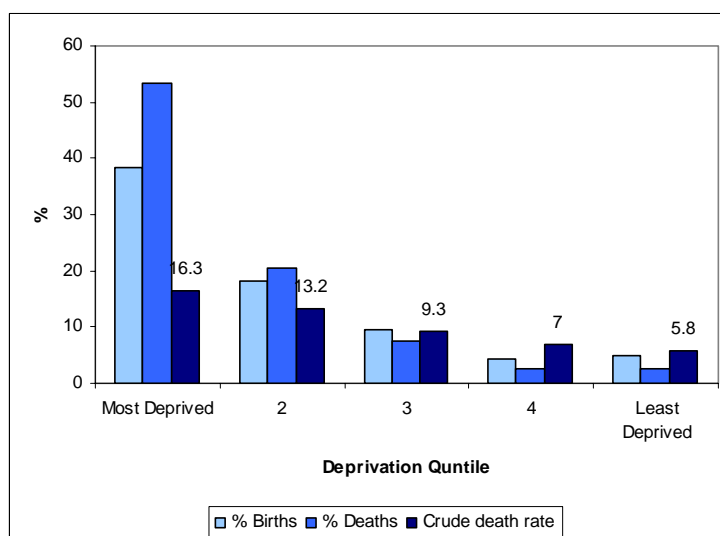
The risk of stillbirth and infant death among White mothers who smoke in pregnancy was 2.9 times higher than for those who did not smoke in pregnancy.

(Odds ratio 2.894, confidence interval 1.478 - 5.661)

4.1.2 Deprivation

The review found a strong association between deprivation and stillbirths and infant deaths. 119 of the 161 deaths at Manor Hospital were of babies born to parents in the two most deprived quintiles of socio-economic classification. Thus 74% of the deaths were in the two most deprived quintiles compared with 57% of the births.

Figure 7: Percentage of Births, Stillbirths and Infant Deaths by Deprivation Quintile, at Walsall Manor Hospital, 2001-2006

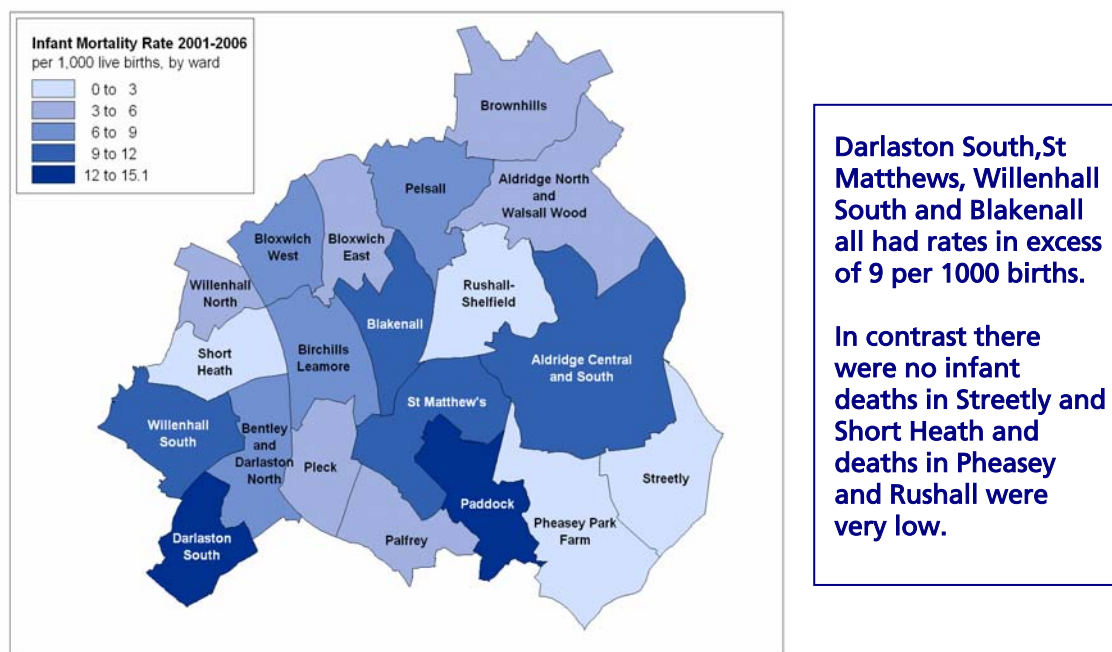


The risk of stillbirth and infant death in the most deprived community (Quintile 1) is over 80% higher than in the least deprived community (Quintile 5).

(Odds ratio 1.836, confidence interval 1.347- 2.508)

The geographic distribution of stillbirths and infant deaths across Walsall wards also broadly reflects the link with deprivation, as illustrated in Map 2 which shows the infant mortality rate of babies born to all mothers resident in Walsall (all hospitals).

Map 2: Infant mortality in all Hospitals by Walsall wards, 2001–2006



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Source: ONS Vital Statistics

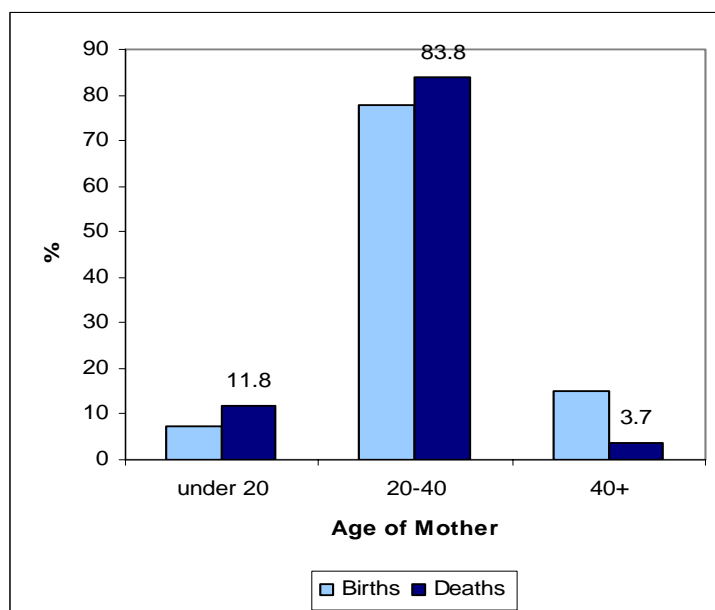
An exception to the deprivation linked pattern is (relatively affluent) Paddock and Aldridge Central and South, where infant mortality rates were also high. This shows a general pattern which has developed in Walsall, where year on year rates of infant deaths have been increasing in Aldridge. Anecdotally Manor Hospital has seen an increase in the number of older mothers in the more affluent areas of Walsall, who have carried on working to a late stage of pregnancy.

4.1.4 Maternal Age and Gestation

It is recommended that pregnant women book into the antenatal care system by the 12th week of their pregnancy. The target is for 80% to book-in under 12 weeks. At Manor Hospital 63.5% of births were to mothers who had booked in under 12 weeks.

Figure 8 shows the pattern of stillbirths and infant deaths in relation to age of the mother.

Figure 8: Percentage of Births, Stillbirths and Infant Deaths by Age of Mother, at Walsall Manor Hospital, 2001-2006



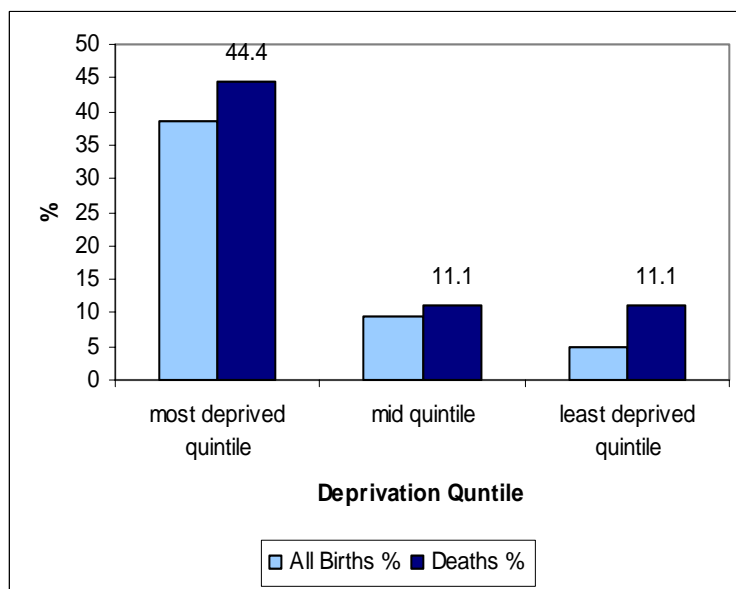
The average age of mothers was 27.6 years.

Nearly two thirds (64.3%) of stillbirths and infant deaths to mothers aged 20-40 were smoking or in the most deprived quintile.

In contrast only 7% of mothers aged over 40 were smokers or in the most deprived quintile.

The gestational age at delivery ranged from 19 to 41 weeks with an average of 31.4 weeks. Extreme prematurity accounted for 18 (11%) of the 161 deaths at Manor Hospital. These were of babies under 24 weeks gestation. In this group, there was a strong association with socio-economic deprivation as shown in Figure 9 below.

Figure 9: Percentage of Births, Stillbirths and Infant Deaths in Babies Under 24 Weeks Gestation, at Walsall Manor Hospital, 2001-2006

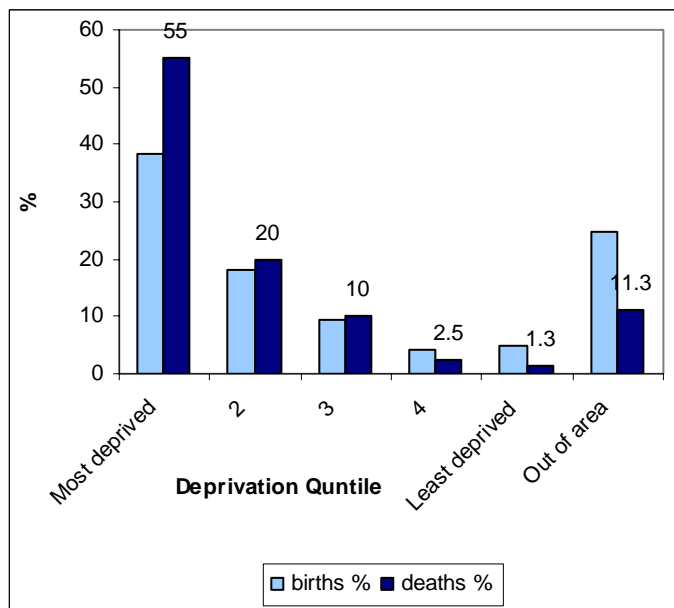


Almost 45% of deaths due to prematurity or extreme prematurity were of babies born to mothers in the most deprived socio-economic group.

However, mothers in the least deprived socio-economic group also experienced higher (prematurity) infant deaths, although absolute numbers were much smaller.

Half of all stillbirths and infant deaths at Manor Hospital (80 deaths) were of babies over 24 weeks gestation and with no congenital problems. Of this group, 75% of deaths were babies of mothers in the two most deprived quintiles of the population (including 55% in the most deprived socio-economic group). This pattern is illustrated in Figure 10.

Figure 10: Percentage of Births, Stillbirths and Infant Deaths in Babies Over 24 Weeks Gestation with no Congenital Problems, at Walsall Manor Hospital, 2001-2006



Over half the deaths of babies over 24 weeks gestation were to mothers in the most deprived socio-economic group, whereas this socio-economic group accounted for less than 40% of births.

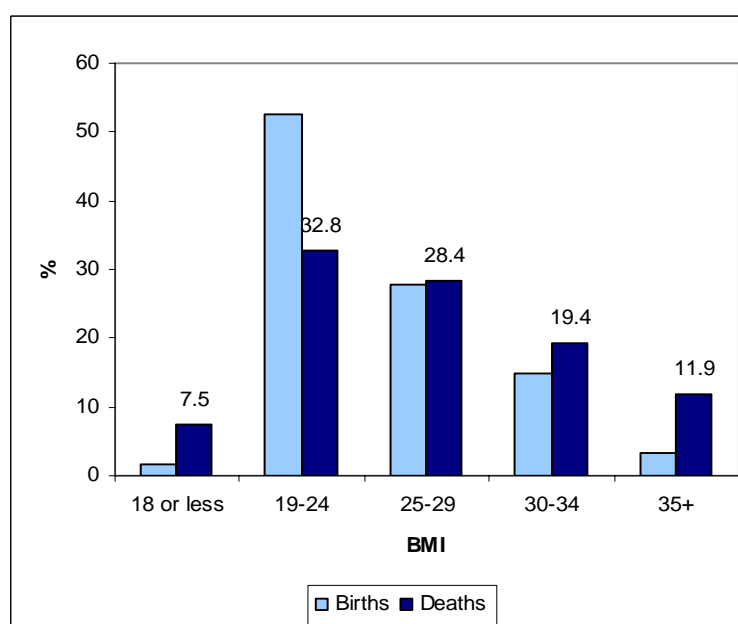
Conversely, only 1% of deaths of babies over 24 weeks gestation were to mothers in the least deprived socio-economic group even though that socio-economic group accounted for 5% of all births at the hospital.

4.1.5 Body Mass Index at Booking

People with a Body Mass Index (BMI) of less than 20 are regarded as underweight, 20-24.9 as normal weight, 25-29.9 as overweight and 30 and above as obese.

BMI was not comprehensively recorded before 2006 and therefore only 41% of mothers in the study had their BMI recorded. Whilst the findings suggest that obese and underweight mothers may be at higher risk of having a stillbirth or infant death, as illustrated in figure 11, the differences are not statistically significant due to the relatively small number of mothers whose BMIs had been recorded.

Figure 11: Percentage of Births, Stillbirths and Infant Deaths in Babies by BMI, at Walsall Manor Hospital, 2001-2006



The risk of stillbirths and infant deaths was estimated to be 30% higher in Walsall mothers with a BMI over 30.

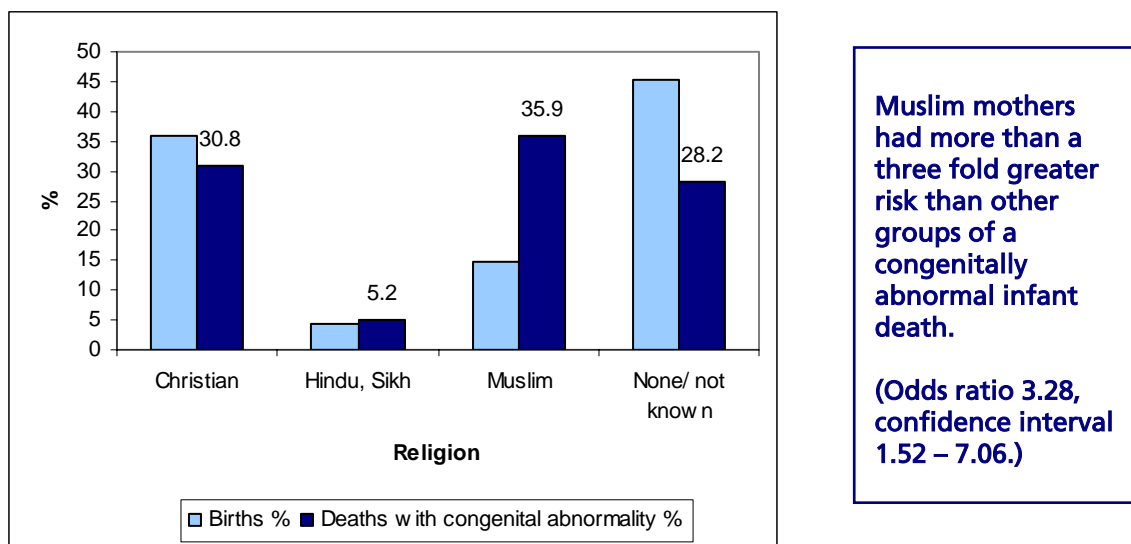
However, this risk estimate was not statistically significant due to insufficient numbers in the sample who had had their BMI recorded.

4.1.6 Deaths of Babies with Congenital Problems

About 25% of the deaths in the review were of babies with a congenital abnormality, 55 in total, of which 39 died at Manor Hospital.

14 of the 39 deaths of congenitally abnormal babies were of babies born to Muslim mothers. Thus, whilst less than 15% of all births were to Muslim women, 36% of deaths of babies with congenital abnormality were of babies born to Muslim mothers (Figure 12).

Figure 12: Percentage of Deaths in Babies with a Congenital Problem by Ethnicity, at Walsall Manor Hospital, 2001-2006



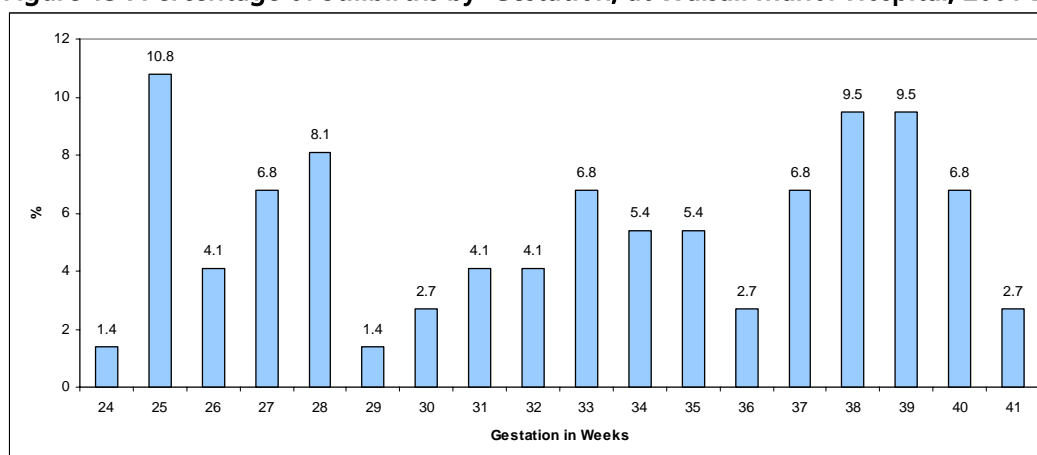
10 of the 39 deaths of congenitally abnormal babies were to mothers in consanguineous marriages. The risk of parents in a consanguineous marriage suffering the death of congenitally abnormal baby is almost twice that of other parents not in consanguineous marriages. (Odds ratio 1.968, confidence interval 0.85 – 4.56)

4.2 Stillbirths

The audit reviewed a total of 74 cases of stillborn babies dying at the Manor Hospital between 2001 and August 2006. A summary of the characteristics of these babies and their mothers is given below.

Gestation at Delivery

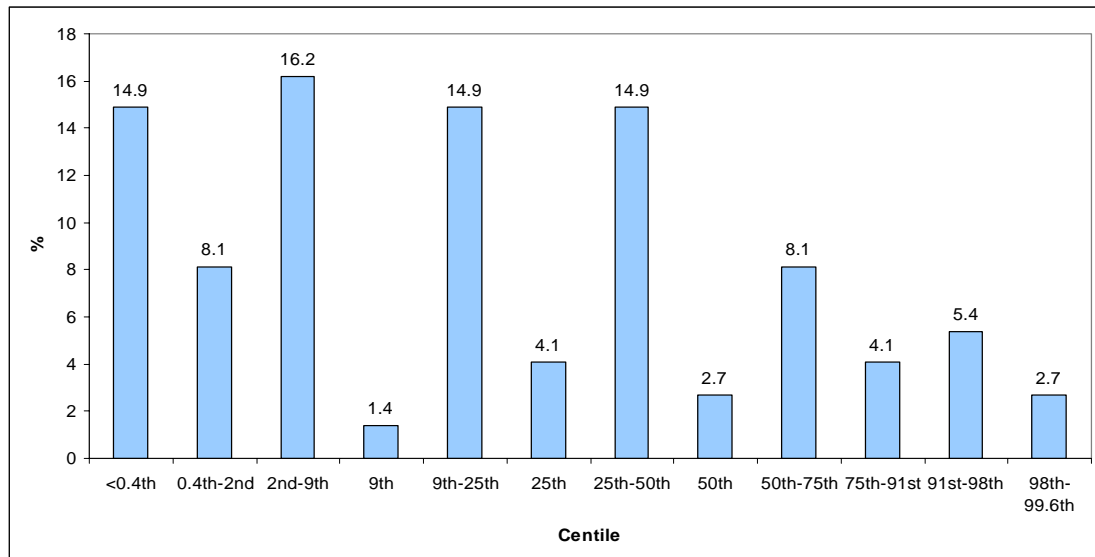
Figure 13 : Percentage of Stillbirths by Gestation, at Walsall Manor Hospital, 2001-2006



There were two peaks in gestational age of the stillborn babies at delivery: at 25 weeks and around 38 and 39 weeks. 12% or 9 babies were delivered under 26 weeks gestation. In addition, 16% (12 babies) were delivered up to and including 26 weeks gestation. The average gestation was 33 weeks.

Weight Centile

Figure 14: Percentage of Stillbirths by Weight Centile at Delivery, at Walsall Manor Hospital, 2001-2006

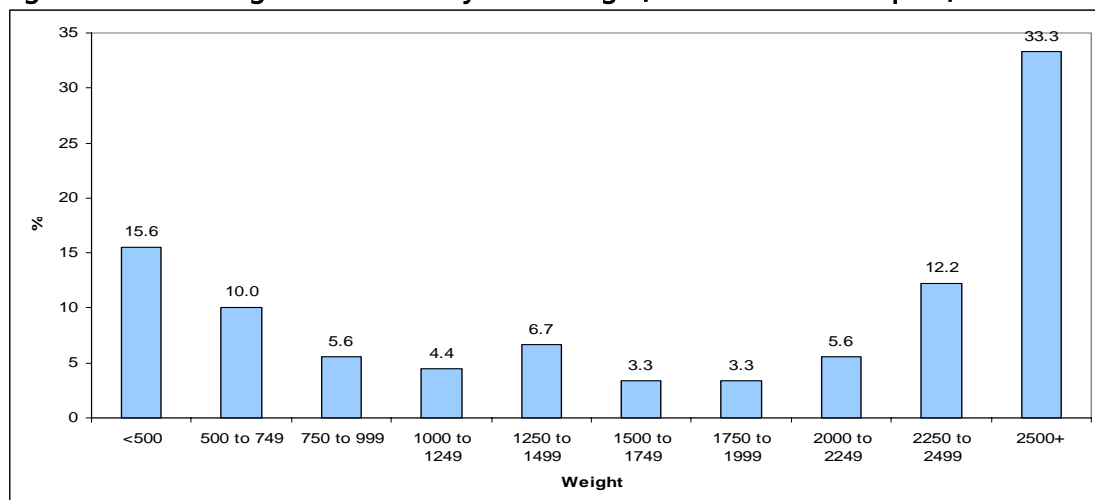


In total, 23% of the stillbirths (17 out of 74 babies) were under the 2nd centile, 40% (30 babies) were under the 10th centile.

A policy is in place within the Hospital Trust to admit babies below the 2nd centile into the neonatal and special care unit. From the audit it is difficult to give a definitive figure but it is likely that between 15% and 23% (11 and 17 stillborn babies respectively) would fall under this policy.

Birth Weight

Figure 15: Percentage of Stillbirths by Birth Weight, Walsall Manor Hospital, 2001-2006



A total of 21 or 28% of the stillborn babies had a birth weight of under 1000 grams.

Smoking

41% of the stillbirths were to mothers who smoked during pregnancy. 56% of the White mothers whose babies were stillborn smoked during pregnancy (27 out of 48 stillbirths to White mothers). One third of their babies were below the 10th weight centile.

Religion and Consanguineous Marriages

Of the 74 stillbirths, 10 were born to parents in a consanguineous marriage. A total of 9 of the 10 babies were born to Muslim women. 60% of Muslim women who had babies that were stillborn were in a consanguineous marriage.

Deprivation

Of the stillborn babies, 51% of their mothers were in the most socio-economically deprived fifth of the population (quintile 1) and of these 47% were smokers. Furthermore, a total of 70% of the mothers were in the most socio-economically deprived two fifths of the population (quintiles 1 and 2) and of these 74% were smokers.

Age of Mother

Age of mother was not a significant factor in stillbirths. The age range of the mothers of the stillborn babies was between 16 and 44 years. The average age was 28.4, which compares to an average of 27.6 years for all Walsall births. The median age of the mother was 27 years.

Employment

Over 55% of the mothers of the stillborn babies were employed. Of those whose occupation was known and who were in a "professional role", all were over 27 years old.

BMI of mother

Of the mothers of stillborn babies where a BMI was recorded, 38% had a BMI of over 30. This is higher than the results for the rest of the study and when compared to the percentage of all mothers giving birth in Walsall (31% and 18% respectively).

Medical Disorders

A previous miscarriage was recorded in 27% of the mothers notes.

Asthma, hypertension, diabetes and kidney problems were also recorded in a small number of cases.

Table 4: Percentage of Medical Disorders of Mothers of Stillborn Infants, Manor Hospital, 2001- 2006

Medical History	%
Hypertension	6.8
Diabetes	6.8
Thyroid	2.7
TB	2.7
Kidney	6.8
Heart Disease	1.4
Asthma	6.8
Depression	5.4
Previous Miscarriage	27.0

Other relevant medical histories for the baby, contained in the notes are listed below:

- APH; placental abruption
- Foetal distress intrapartuma
- Group B Strep grown from maternal blood culture and HVS, and foetal pharyngeal swab
- Induction of labour due to PROM
- IUGR secondary to placental insufficiency
- Maternal PET
- Oligohydramnios
- Pale placenta; offensive liquor
- Placental swab - Pseudomonas Aeruginosa
- Trisomy 21; Severe Hypoxic Ischaemic Brain Injury

Post-mortems and Cause of Death

A post-mortem was recorded in the notes in 30% of the stillborn cases. The causes of death from the files are listed below. The majority were unexplained stillbirths or left blank with no further information recorded.

Table 5: Percentage of Cause of death for Stillbirths, Manor Hospital, 2001- 2006

Cause of Death	%
Twin-to-twin transfusion	1.4
Dysmorphic features	1.4
IUGR	2.7
Placental abruption	1.4
Placental thrombosis	1.4
Prematurity	1.4
Sedaghatian type of skeletal dysplasia	1.4
Unexplained	67.6
Unexplained Intrauterine Death	1.4
Blank	21.6

4.2.1 Stillbirths Over 26 Weeks Gestation and Above the 10th Weight Centile

40 of the 74 stillbirths in the study were over the 10th centile and above 26 weeks of gestation at birth. A summary analysis of these cases is given below.

Smoking

18 (45%) of these stillbirths were to mothers who smoked during pregnancy. As in the previous section, the data seems to show that, although there is some correlation, smoking and deprivation appear to be independent risk factors of each other.

Religion and Consanguineous Marriages

23% of these stillbirths were to Muslim mothers (9 women), compared to Muslim mothers 15% share of all births. Of these 9 mothers, 7 (78%) were in consanguineous marriages.

Deprivation

Half of these stillbirths were to mothers in the most socio-economically deprived fifth of the population (quintile 1) and 65% were to mothers in the most deprived two fifths of the population (quintiles 1 and 2).

Employment

A total of 35% (14) of the mothers were employed. This included 11 aged 27yrs or over. Of those employed, 50% were in a "professional" job role and all of these women were aged 27 and over.

BMI of mother

Of the mothers in this group where a BMI was recorded, 35% had a BMI over 30. This is higher than the results for the rest of the study (31%) and the overall birth results (18%).

Post-mortems and Cause of Death

A post-mortem was recorded in the notes in 28% of cases. The causes of death from the files are listed below. The majority were listed as prematurity or unexplained.

Table 6: Percentage Cause of Death for Stillbirths Over 26 weeks Gestation and Above 10th Weight Centile, Manor Hospital, 2001–2006

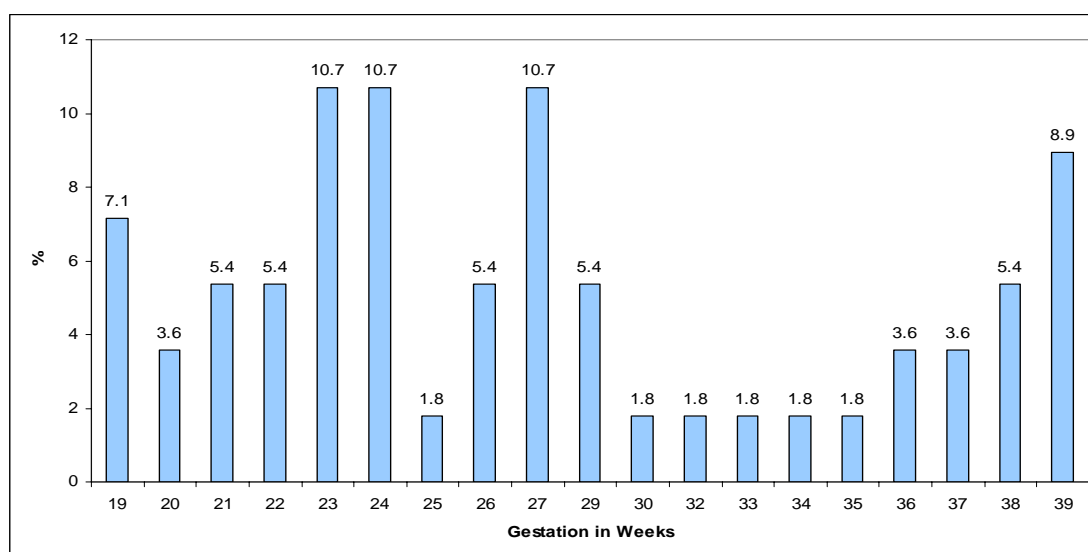
Cause of Death	%
Congenital abnormalities	12.5
Dysmorphic features	2.5
Placental abruption	2.5
Placental thrombosis	2.5
Prematurity	65.0
Stillbirth	5.0
Unexplained Intrauterine Death	20.0
Blank	2.5

4.3 Early Neonatal Deaths (Death Within 7 days)

The review found that 56 babies died at Manor Hospital before they were 7 days old from 2001 - 2006.

Gestation at Delivery

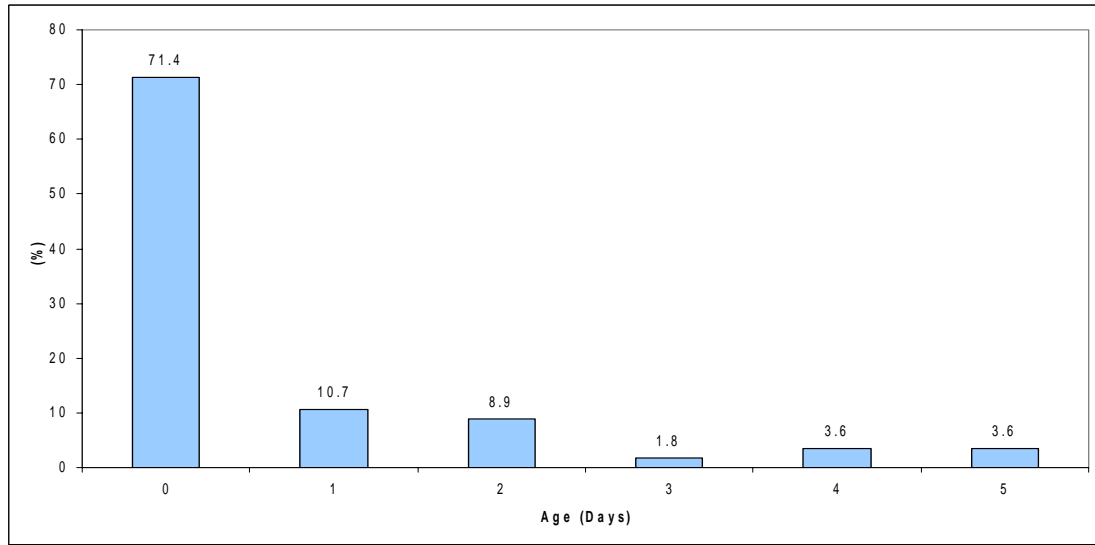
Figure 16: Percentage of Early Neonatal Deaths by Gestation at Delivery, Manor Hospital, 2001-2006



43% of the early neonatal deaths were up to and including 24 weeks gestation at delivery. There was also a second peak in age at delivery around 27 weeks.

Age at Death

Figure 17: Percentage of Early Neonatal Deaths by Age in Days, Manor Hospital, 2001-2006



Over 70% (40) of the deaths were in babies less than 1 day old and only 18% of the deaths were of babies aged 2 days old and older.

Cause of Death

The main causes of death for the early neonatal babies were prematurity (accounting for 48% of deaths) and congenital anomalies, including multiple anomalies which accounted for 13% of deaths.

4.4 Post Neonatal Infant Deaths (deaths at 29 days to one year)

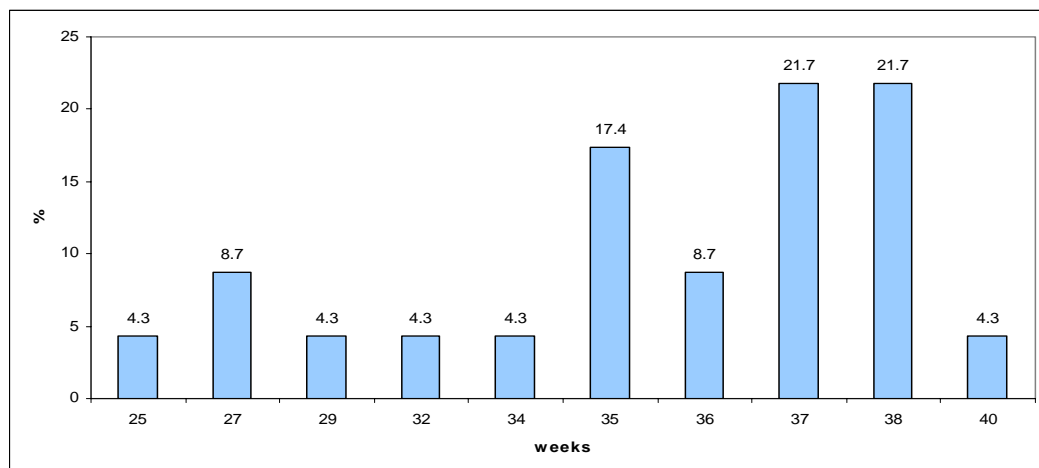
The audit reviewed a total of 40 cases of infant deaths, of which 23 recorded the place of death as the Manor Hospital from 2001 - 2006.

The summary of the characteristics of these babies and their mothers are detailed below.

Gestation at delivery

All of the babies were 25 weeks and over gestational age at delivery.

Figure 18: Percentage of Infant Deaths by Gestation at Delivery, Walsall Manor Hospital, 2001-2006



Weight Centile

Table 7: Percentage of stillbirths by Weight Centile, Manor Hospital, 2001- 2006

Weight Centile	%
9th-25th	26.3
25th	5.3
25th-50th	26.3
50th-75th	21.1
75th	5.3
75th-91st	5.3
91st-98th	10.5
Total	100

Congenital Problems

10 out of the 23 babies were born with a congenital problem. Of the mothers, 60% were Muslim and 40% were in a consanguineous marriage. The problems were identified as:

- ARC Syndrome
- Complex Congenital Heart Disease
- Congenital CMV Infection
- Dysmorphic Features
- Heart Failure; polymicrogyria; undescended right testes; skeletal disproportion; sterol metabolism disorder
- Multiple Cardiac Anomalies
- Spinal Muscular Atrophy Type 1

Of the remaining babies, 13% did not have a congenital problem and 20% of cases did not record a congenital problem.

Cause of Death

The cause of death for all these babies where a congenital problem was not listed:

- Acute Respiratory Failure
- ARC Syndrome
- Bilateral Bronchopneumonia
- Hypoxic Brain Injury
- Pneumothorax
- Septicaemia
- Sudden Infant Death Syndrome (SIDS)
- Unascertained

Sudden Infant Death Syndrome (SIDS) was identified in a small number of cases. There has been a change of policy in this area on parents sleeping with baby, emphasising warnings about this. SIDs have also been associated with smoking and deprivation. In this study all the mothers were in the most deprived 2 quintiles, whilst the mother in the most deprived quintile was also a smoker.

4.5 Conclusion

The review has identified a number of key factors associated with excess risk of stillbirth and infant death in Walsall: smoking in pregnancy, deprivation, consanguineous marriages and high BMI. These findings are consistent with other regional and national research into infant deaths (summarised in Appendix 2). Over 50% of these deaths may be preventable by addressing these excess risks. (see Executive Summary and Appendix 1).

Public health population based interventions and service development plans need to be targeted to address these issues and achieve a sustained reduction in stillbirths and infant mortality in Walsall (see Recommendations, section 1.2).

5. Acknowledgements

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Birmingham Womens Hospital

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APPENDIX 1

ESTIMATE OF POTENTIAL REDUCTION IN STILLBIRTHS AND INFANT DEATHS IN WALSALL BY ADDRESSING EXCESS RISK FACTORS

Method of estimation:

Apply "Odds Ratio" (identified in report) associated with the risk factor to the number of stillbirth and infant deaths reviewed at Manor Hospital. N=161 deaths 2001-2006.

Excess risk factor	Number of deaths in review associated with risk factor	Odds ratio	Number of potentially preventable deaths (2001-2006) out of 161 deaths	Percentage of total deaths preventable
Smoking in pregnancy (White women)	48	2.89:1 CI 1.48-5.66	36 range 29-41	22%
Consanguineous marriage	24	3.18:1 CI 1.47-6.88	18 range 14-21	11%
Socio-economic deprivation	86 (quintile1)	1.84:1 CI 1.35-2.51	56 range 49-61	35%
BMI of 30 or above*	21*	1.35:1 CI 0.52-3.53	12 29#	18%#

*41% of sample only had BMI recorded.

29 is the number of preventable deaths if 100% of the sample had had their BMI recorded and the stillbirth and infant death rate was same as in the sample where BMI had been recorded. In this case 18% of the total deaths would be preventable.

As smoking in pregnancy and consanguinity are largely confined to separate population groups, the potentially preventable deaths for these categories are additive - ie up to one third of total deaths could be prevented if smoking in pregnancy were eliminated and couples had not entered into consanguineous marriages.

Socio-economic deprivation and high BMI may also be a confounding factor affecting these two groups, as well as being a risk factor for the larger group of non smokers and mothers not in consanguineous marriages. This means that the potential preventable deaths from addressing the four excess risk factors are not crudely additive (to 86% of all deaths). However, it seems likely that over 50% may be preventable if all these factors were effectively addressed.

APPENDIX 2 - LITERATURE SEARCH

Most infant deaths occur in the first week of life.¹ Only 30% of infants who die have a post-mortem.¹ The reasons for this is generally unknown. Pakistani and Bangladeshi babies have the lowest proportion of postmortems undertaken. This may be due to the Islamic belief that bodies should be unchanged from birth to death by external means.

Age of Mother

- Mothers aged less than 20 or 40+ have higher odds of having a child die within 1 year of life^{1,2,3,4,5,6,7} than mothers aged 30-34. With mothers aged less than 20, the risk is 47%¹-60%⁸ higher, and mother aged 40+, the risk is 25%¹ higher than the average Infant Mortality Rate (IMR).
- The causes of infant mortality due to maternal age can differ. Large percentages are attributed to congenital anomalies, 18.7% for babies born to mothers aged <20, and 39.4% to mothers aged 40+.
- The highest proportion of death in babies of mothers aged <20 was due to severe pulmonary immaturity (27.3%). This cause accounted for 26% of infant mortality in babies born to mothers aged 40+.
- Another cause which differentiated the 2 age-groups was cot death, which was 5 times more common in babies born to women <20 compared to mothers aged 40+. This cause was attributed to 15% of deaths of babies born to women <20, whereas it only accounted for 2.9% of deaths in babies of women aged 40+.
- The other causes accounted for similar proportions of infant mortality between the 2 age groups.
- The causes attributed to infant mortality have changed slightly from 1997-2001 to 2002-2005. Whilst the proportion of infant mortality attributed to congenital anomalies, intrapartum asphyxia, hyaline membrane disease, infection, and cot death have decreased, the proportion attributed to severe pulmonary immaturity (from 26.8% to 34%) and intracranial haemorrhage (from 1.8% to 2.1%) have increased.¹

CAUSE	1997-2001	2002-2005
Congenital Anomalies	28.5	25.3
Intrapartum Asphyxia	4.6	3.8
Severe Pulmonary Immaturity	26.8	34
Hyaline Membrane Disease	7.9	2.9
Intracranial Haemorrhage	1.8	2.1
Infection	12.7	12.4
Cot Death	7.1	6.4
Miscellaneous	7.7	10.9
Unclassified	2.9	2.1
Total	100	99.9

BMI of Mother

- Using 20 – 24.9 as the reference due to it being the ideal BMI, mothers in the other BMI groups were compared against to determine the effect of maternal weight on the baby.¹ Underweight, overweight, and obese mothers were found to have babies who were at higher risk of dying within 1 year.⁷
- The data provided show women with a BMI of less than 20 or 35+ have slightly higher odds of having a child who will die within 1 year of birth, whereas women with a BMI of 25-29.9 have slightly reduced odds of having a child die within 1 year of birth.¹ However, the confidence intervals (CIs) for these BMI groups overlap¹ (the reference value for BMI 20-24.9), therefore they are not statistically significantly different.¹
- Women with a BMI between 30 and 34.9 have 1.44 times the odds of the reference BMI of having a child die within 1 year of live birth. This finding is statistically significant as the lower confidence interval does not cross 1.1
- Research shows foetal growth restriction is easier to detect in thin mothers.¹

Social Class/Deprivation

- Using the Index of Multiple Deprivation 2004 to determine social deprivation, infant mortality rates of most deprived class (V) and the less deprived classes (I – IV) in the West Midlands were compared. The mortality rate was found to have decreased for infant deaths in both groups from 1997 – 2005, but the gap between the groups was still very wide. For class V, the mortality rate decreased from 9.6 in 1997-1999 to 9.3 in 2003-2005. For classes I – IV, it fell from 5.8 to 5.6 in the same time period,¹ meaning the most deprived classes had a higher risk of infant mortality.⁵

- Perinatal deaths – IMD class V - In 1997-1999, the mortality rate was 12.3. This rose to 14 by 2003-2005. For Classes I – IV, the mortality rate dropped from 8.8 in 1997-1999 to 8.3.1
- The IMR is higher in unmarried women than in married women.² The rate is higher in mothers with sole responsibility of the baby, rather than an unmarried couple sharing responsibility of the baby.^{5,6} Births within marriage have decreased by a third from 1976 to 1998, whilst births outside marriage have quadrupled in the same time period.⁸
- Being from a lower socioeconomic class can affect maternal weight,³ both pre-body BMI and weight gain during pregnancy due to not being able to afford food^{3,4,6,7} or ill-education about benefits of eating healthily for optimum foetal growth.
- Factors such as age of mother (teenage pregnancies), low and very low birth weight, and couples in routine and manual classes are all affected by deprivation.

Birthweight

- A baby's birth weight is an indicator of internal development and it's potential to survive, which can be affected by 2 factors:^{2,3,4,5,6,7,9,11}
 - Premature birth and therefore lack of foetal development;
 - Birth at full term, but mother malnourished during pregnancy leads to an underweight baby.
- 64% of all infant deaths are of babies who were born weighing less than 2500g.²
- The mortality rates based on birth weight are as follows:⁸
 - Very Low birth weight - Under 1500g = 227.9 deaths per 1,000 births;
 - Low birth weight < 2500g = 49.7 deaths per 1,000 births;
 - 2500g+ = 2.6 deaths per 1,000 births.

Smoking

- Women who smoke during pregnancy have a higher risk of giving birth to a baby who will die within 1 year of life.^{2,6} This is because smoking during pregnancy is attributed as being a cause of low birth weight in babies. The incidence of babies with low birth weight being born to smokers is twice that of non-smokers.^{3,4,5,6,7,9}
- Smoking after pregnancy can also have adverse effects on the baby, such as SIDS, due to passive inhalation of the smoke.^{6,7}

Alcohol/drugs

- Drinking alcohol and taking drugs also affects foetal growth, possibly leading to low birth weight due to limited development of organs in the foetus.⁶

Ethnicity

Using mothers of European origin as the reference, African/Caribbean, Indian and Pakistani mothers in the West Midlands were compared against to determine whether ethnicity had an impact on the risk of infant mortality.¹

- The data showed there was a statistically significant increased risk of perinatal death in babies born to African/Caribbean, Indian and Pakistani women.
- African/Caribbean women had an 82% higher risk.
- Pakistani women had a 63% higher risk.
- Indian women had a 32% higher risk.
- There was also a statistically significant increased risk of infant death in babies born to African/Caribbean women (1.72), and Pakistani women (1.63).
- The findings were not statistically significant in Indians as the CI overlapped 1.
- Infant deaths which excluded anomalies and pre-viable births showed a statistically significant increased risk in African/Caribbean women.
- A study in Sheffield also yielded results which found Black, Asian and Chinese and other ethnicities had a higher risk of infant mortality in comparison to Whites.³
- The Bradford District Infant Mortality Commission (BMIMC) found infant mortality to be 5 times higher in the most deprived area in comparison to the least deprived area.⁶

Consanguinity

- The BDIMC identified congenital anomalies, in particular autosomal recessive disorders to be the most likely cause of death in babies of Pakistani origin than in White babies.⁶ This is linked to consanguineous marriage, which is marriage between relatives. If both set of parents have the recessive alleles, conception between the two will lead to a larger likelihood of conceiving a child with both recessive alleles.

Family Size

- A woman's first baby has the highest risk of dying within the first year.⁶ The second child has the lowest risk, and then the risk grows with each subsequent child. This could be due to age, as the woman is getting older, and she may be at the at-risk age when she has her subsequent children.⁷

Women's Education

- A study in America found that women who didn't complete their high school education had twice the rate of infant mortality than women who had completed a higher degree.² This is another factor related to social deprivation.

Vaccinations

- Vaccinations for Diphtheria, Tetanus, Pertussis (Whooping Cough), Poliomyelitis, Haemophilus influenzae type B, Meningococcal disease type C, and Pneumococcal disease are given to babies within their 1st year of life. Uptake rate of these vaccinations are lower in poorer families.⁷

Midwives

- The data shows that the more cases undertaken by a midwife, the higher the perinatal mortality rate.¹ This was steeper in Birmingham than the Black Country. This could be explained as being because midwives have less time to provide the best service required due to their heavier caseloads.

Breastfeeding

- Low breast-feeding uptake is more common in the more deprived classes.⁴

Environmental Effects

- There is growing evidence that air pollution does have an effect on "pregnancy outcomes and infant health".³ However, investigations of the environmental effects on infant mortality are in the early stages and more research needs to be done.
- A US study looking at PM10 at a concentration of 10µg/m³ indicates there is potentially a slight effect on post-neonatal infant mortality. The findings given were statistically significant, showing a 16% higher risk of Sudden Infant Death syndrome (SID) and 24% higher risk of respiratory disease mortality.¹⁰

Baby's Gender

- Infant mortality was higher in males (8.0) than females (6.6) in 1996.^{2,7}

Parity

- Infant mortality is 5 times higher in multiple birth pregnancies compared to single birth pregnancies.²
- Research in Sheffield found this risk was 7 times greater for neonatal infant mortality, and 3.2 times greater for stillbirths.³
- An American study also found that multiple births coupled with low- and very low birth weights gave rise to a further increased risk of mortality.¹¹ Compared to single babies born within the optimum weight, single babies of very low birth weight (VLBW) had a 14% increased risk of dying within their 1st year of life, VLBW twins had a 96% increased risk of dying within 1 year of life, and VLBW triplets and more had a 450% increased risk of dying within the first year of birth.¹¹

Mother's Health

- HIV
- Uninfected infants have an increased risk of mortality. Possible reasons include: "diminished care giving capacity", and the effects of "interuterine viral exposure", maternal immunosuppression on the developing foetal immune system", "maternal depression", and "nutritional deficiencies in breast milk".¹²

Antenatal Detection - Screening

- Early antenatal booking is needed to ensure full support and effective care and advice is given throughout the pregnancy. 4,5,6,7
- Prospects are better for those who book within 12 weeks of conception. 4,5
- Screening enables expectant mothers to make difficult choices if needed, and treat infections which may arise.⁷
- The quality of obstetrics and neonatal care also needs to be of a high standard if infant mortality is to be prevented.^{4,6}

Diabetes⁶

- Care needs to be provided to and by women who are at risk of developing gestational diabetes or who are already diabetic, as this condition can also affect the development of the fetus.

Pre-Eclampsia

- Pre-eclampsia can cause women to go into labour early.¹³ This means the foetus may not be fully developed when it is delivered.

Other Risk Factors

- Laying the baby to sleep on their front or side can lead to an increased risk of SIDS.⁷

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**APPENDIX 3
PROTOCOLS FOR COLLECTION OF DATA AND CASE NOTES**

Mother's Name: Hospital No: Age:

Address:

***Postcode:**

Child's name: Hospital No: * Date of Death:

Date of Birth:

Child's Place of Birth:

GP's Name:

***Address:**

*** Postcode:**

Country of Birth: Mother:

Ethnicity: Mother: Father:

Religion: Mother: Father:

Marital Status:

Employed: Mother: Yes No Father: Yes No

Occupation: Mother: Father:

Language: English Hindi Punjabi Urdu Bengali Other

Interpreter needed: Yes No NK

Consanguineous marriage: Yes No NK

BMI at Booking:

Medical history Of Mother

Hypertension	Yes	No
Diabetes	Yes	No
Thyroid	Yes	No
Fertility problems	Yes	No

Previous miscarriages: Yes No
 TB Yes No
 Heart problem Yes No
 Abnormality:
 Clotting problem Yes No

Current pregnancy

Kidney/ urinary problem Yes No
 Gestational age at booking:
 Dating scan done: Yes No
 Any Other Problem
 Outcome:

Family history:

Diabetes Yes No
 Hypertension Yes No
 Thyroid Yes No
 TB Yes No
 Heart problem Yes No
 Clotting problem Yes No
 Genetic illness Yes No
 Still birth Yes No
 Sudden infant death Yes No
 Any congenital illness Yes No

Hb levels at booking:

Any Abnormal Screening Results:

Hypertension: Yes No
 IUGR: Yes No
 SROM: Yes No
 GBS: Yes No

Intrapartum Management

Any other illness Yes No
 Any bleeding Yes No
 Drug history:
 Any CTG abnormality noted Yes No
 Alcohol intake: Yes No
 If yes, Units/wk:
 If yes, PH BE
 Recreational Drugs: Yes No

Smoking: Yes No
 If yes, number of cigarettes per day:
 Any FBS indicated Yes No
 If yes, was FBS done Yes No

Mode of delivery

Gravida /Parity:
 Outcome: 1] 2] 3]
 Instrumental delivery Yes No
 Emergency caesarean section Yes No
 Elective caesarean section Yes No

Any complication during labour Yes No

If yes, detail please:

Apgar score at delivery: at 1 minute 5 minute 10 minute

Cord PH BE

Need for admission at NICU Yes No

Any unexpected NICU admission Yes No

Any abnormality:

Gestational age at delivery:

Date of Delivery:

Weight Of the Baby:

Breast Feeding: Yes No

Post-mortem: Yes No

Cause of Death: 1.

2.

3.

***General Information**

1. PCT Region:

2. Deprivation:

3. Council:

4. Wigglesworth Code:

5. Others:

Proforma - Infant

Presenting Condition:

Any relevant Medical History:

Any Congenital Problems:

If yes, detail please.....

Any problems with Siblings: .Yes . No

If yes, details including deaths (if documented)

Drug history:

History of allergy: .Yes . No

Up-to-date with Immunisation: .Yes . No

Height:

Weight:

Development problems: .Yes . No

Any Neonatal problems: .Yes . No

Any Foreign travel: .Yes . No

Any contact with Infectious diseases or contacts: .Yes . No

Any Accidents: Yes .No

Any Feeding Problems Yes No

Social Service Involvement: Yes No

Bed Sharing: .Yes . No

Lives with

No of Previous Admissions to Hospital:

Reasons for each admission:

(Please use back of this sheet if required)

No of A& E Admissions:

(If recorded)

Underlying Diagnosis/Condition:

Please record, details on Breast feeding, h/o parental smoking, or any other relevant history in maternal proforma