PREVENTING LOW BIRTH WEIGHT
AND PRETERM BIRTH
A Review of Selected Literature

Vivienne Morrell
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Foreword

Numerous factors can be defined as important outcomes of the perinatal period, ranging from maternal or neonatal mortality to maternal satisfaction with childbirth services. In the past, most attention has been focused on the prevention of mortality, with excellent results by world standards. More recently, the women's health movement has challenged long-held assumptions about the effectiveness of some aspects of traditional obstetric care, and has directed attention to the issues of informed consent and choice, and the outcome of health care user satisfaction.

Apart from a few notable exceptions, such as the Middlemore Hospital Teen Clinic, the challenge of preventing the other adverse perinatal outcomes such as low birth weight or preterm delivery has received little local attention, despite the considerable and growing expenditure on neonatal intensive care resulting from these problems. Indeed, none of the area health boards is able to determine overall coverage of prenatal care, let alone monitor coverage of high risk groups.

Similarly, risk-related prenatal or early postnatal intervention to prevent later adverse outcomes, including child abuse or infant ill-health, has not been widely adopted, in spite of an innovative local model in the work at Dunedin's Queen Mary Hospital. This is in contrast to other developed countries, many of which are conducting continuing large-scale research as well as implementing risk-related care as a standard feature of their childbirth services.

This thorough review by Vivienne Morrell of recently-published research looks mainly at the problems of low birth weight and preterm birth, but also considers other adverse outcomes in the perinatal period or infancy. The review clearly shows that, while there have been failures as well as successes amongst prevention programmes, other factors need to be considered before deciding results are inconclusive. The types of interventions used, their 'fit' with the population involved, and the method of deriving risk factors are all crucial to a programme's success.

Interestingly, the chances of success appear greatest when local epidemiological data are used to define risk criteria, and when the low birth weight rate is already relatively low. One only has to consider the immense barriers to success in the deprived and declining suburbs of some large American cities to realise why some programme failures have occurred.

New Zealand would appear, therefore, to offer a good opportunity to investigate and implement low birth weight prevention. We have a relatively low rate of low birth weight, which is nevertheless increasing alarmingly as the statistics in Section 5 attest. Our area health boards should be motivated to run prevention programmes, as boards are not only charged with improving health status but are also in a position to be advantaged by the 1:3 prenatal care to neonatal care cost-effectiveness ratio documented by the United States Institute of Medicine.
What, then, needs to happen? Boards need a computerised perinatal information system in order to collect risk factor data, use it to identify high risk groups, and continually improve the effectiveness of their services. The Department of Health has issued a national 'blueprint' for a perinatal information system and a number of boards are now moving to develop it.

Boards also need a commitment to shift resources to those women who need extra care, in the knowledge that this investment will be repaid through the improved health status of these women and their infants. Until now, when such shifts have occurred, they have been small, allowing the delivery of 'priority care' to a limited number of women. Overseas evidence suggests that the extension of such a service to at least 20 percent of the maternal population may be cost-effective.

Childbirth service providers need to gain an understanding of risk-related care and to review the way their service is being managed. The private enterprise concept of 'niche marketing' is highly relevant to prenatal care. For example, as Maori women have a relatively high low birth weight rate (8.7%), and may be under-utilising present prenatal care services, there is a good case for a bicultural component to the service, offering high quality prenatal and postnatal care in a Maori setting. Successful models for such a service, which is entirely consistent with the health services' commitment to the principles of the Treaty of Waitangi, already exist.

Research should be an important part of risk-related care. New Zealand has already produced two important observational studies of child development. This review shows that there is now sufficient information available for us to shift our attention to interventional research in this area.

Michael Soljak
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Women, Child and Family Health Programme
January 1990
Acknowledgements

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Graeme Prestidge, of the Department of Health library, carried out a thorough literature search, which helped me to locate relevant material.

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Vivienne Morrell
April 1990
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Introduction

Significance of low birth weight

Low birth weight (LBW) is a major determinant of infant mortality and morbidity. In the United States LBW infants are almost 40 times more likely to die during their first four weeks of life and five times more likely to die between 28 days and one year than normal birth weight infants (United States Institute of Medicine Committee to study the Prevention of Low Birthweight 1985:1-2). In New Zealand in 1986, 5.7 percent of babies were LBW, whereas LBW babies made up 56 percent of neonatal deaths (neonatal = live birth to 28 days) (National Health Statistics Centre 1988:71).

LBW infants also appear to be at increased risk of a variety of health problems, such as neurodevelopmental problems and respiratory tract infections (United States Institute of Medicine 1985:3-4).

Many studies have shown that LBW and preterm delivery (PD) can be reduced. Some of these are reviewed in this paper. It is not possible to eliminate LBW and PD entirely, but Papiernik (1984a:315) believed the rate of preterm births that could not be prevented was about two to three percent. A study by Herron et al. (1982) found that one percent of preterm births were intentionally delivered early because of maternal or fetal disease.

Background to this review

This literature review was requested by the Women, Child and Family Programme of the Department of Health in 1988. The Programme is involved in a number of activities in this area, including primary prevention (i.e., attempting to prevent pregnancy in high risk groups, such as adolescents). In the area of secondary prevention (i.e., intervention during pregnancy), the Women, Child and Family Programme was interested in the possibility of a programme being developed in New Zealand using a risk approach, which many overseas programmes use. A member of the Programme, Dr Michael Soljak, travelled overseas in 1988 and visited a number of people working in this field (Soljak 1988).

The literature reviewed was selected in three main ways:
- articles collected by Dr Soljak both in New Zealand and overseas
- the Department of Health library conducted a literature search, using the Medline database for material published from 1980 to the end of 1988, and the Health Planning and Administration database
- articles were collected from references made to them by other authors

The literature in this field is vast and this review could not hope to cover it all. The selection was based on its relevance to the terms of the client’s request.
particular, clinical trials that used one or two medical methods of attempting to prevent preterm birth were generally not reviewed.

Most of the English language literature comes from the United States of America. One Canadian study was found but there seems to be little in the way of multi-component prevention programme literature from the United Kingdom or Australia, for example. Although it is known that a few trials are going on in these countries, not much has yet been reported. Two useful critiques of the literature were, however, found in Australian journals (Lumley 1988a; Bryce and Stanley 1985).

The paper is in three main parts, reflecting the request from the Women, Child and Family Programme. The first section covers some general strategies (including the risk approach) and specific programmes used to try to prevent low birth weight and preterm birth. The second section discusses the risk factors and methods for assessing risks that have been used in this area. The third section summarises some available New Zealand statistics. A final section attempts to draw this together.

Definitions

Low birth weight (LBW) is defined as birth weight under 2500 grams (5.5 pounds), and very low birth weight is classified as under 1500 grams.

Preterm birth (PB) is usually defined as birth occurring before the thirty-seventh week of gestation. However, there is some variation in the definitions given for preterm birth. For example, Hoffman and Bakketeig (1984) defined very preterm as 16 to 27 weeks; preterm as 28 to 35 weeks and mildly preterm as 36 to 38 weeks. The United States Institute of Medicine Committee to Study the Prevention of Low Birthweight defined preterm birth as the duration of pregnancy less than 37 weeks from the last menstrual period (1985:2).

Low birth weight can be caused by a short gestation (prematurity); by intrauterine growth retardation (IUGR – low birth weight but over 37 weeks of gestation); or it can be a combination of IUGR and prematurity (Kramer 1987a:502). This is important because the risk factors may be different for the different causes of LBW. Also, the preterm baby usually requires more intensive care (and therefore greater cost) than a LBW full-term baby (Ershoff et al. 1983) and has a greater perinatal mortality rate (Ernest et al. 1988).

In the absence of adequate information about the basic causes of low birth weight, a large body of information has developed about risk factors, or factors whose presence in an individual woman indicate an increased chance of bearing a low birth weight baby (United States Institute of Medicine 1985:5-6). As Backett et al. have stated, ‘risk factors are characteristics which have a significant association with a defined outcome’ (1984:10).
Prevention strategies

Population approach versus risk approach

The two main strategies are population wide interventions and a risk approach. Lumley has written that:

The traditional medical approach to prevention has been to identify 'high risk' individuals and offer them some individual and specific protection. In contrast the population strategy aims to control the determinants of preterm birth in the population as a whole... Most action on the prevention of preterm birth has so far used the high risk strategy (1988a:101).

Population wide strategies

The United States Institute of Medicine Committee to Study the Prevention of Low Birthweight (1985) recommended a number of population wide strategies, some beginning before pregnancy:

• enlarging the content of health education related to pregnancy (the authors suggest six topics that should be included);
• improving the provision of family planning services;
• finding means of providing prenatal care to all pregnant women; and
• making specific revisions in prenatal care (including a risk assessment)

Very few studies seem to have used a population-wide approach to preventing LBW or preterm birth. In France a perinatal care programme was introduced in 1970, with the aim of reducing the number of deaths and injuries occurring during the perinatal period (Chapalain 1978). A range of actions was taken and by 1976 it was found that pregnancy was better supervised, delivery took place more often in the presence of an obstetrician, and more modern techniques were used than in 1972. The proportion of children born without any abnormalities increased significantly (Chapalain 1978:202). This programme may have helped contribute to a population-wide reduction in the incidence of preterm birth.

Standard prenatal care could be considered a population approach. The United States Institute of Medicine Committee to Study the Prevention of Low Birthweight found that:

After a comprehensive review of the literature on the value of prenatal care, the committee concluded that the overwhelming weight of the evidence is that prenatal care reduces low birth weight (1985:20).

Kramer (1987a) found prenatal care was not a significant determinant of intrauterine growth. His meta-analysis of 895 studies may, however, have 'diluted' the effects of any potential benefits of prenatal care in high risk groups by a lack of impact in the larger group of women without complications (Kramer 1987a:505).
A New Zealand study of antenatal education classes, often quoted in the overseas literature, found that the classes did not ensure an easier or less complicated childbirth (Gunn et al. 1983). In fact, those who attended antenatal classes had a significantly longer second stage in labour and required more forceps deliveries compared to non-attenders. The authors surmised that more anxious women attended the classes or that the information given possibly increased their anxiety. However, the authors did not measure the effect of antenatal education on LBW.

One problem with standard prenatal care is that it often does not reach the groups most at risk of a variety of adverse pregnancy outcomes. This could be a reason why the emphasis on using a risk approach to prevention has developed. Hutton et al. (1982) looked at the sociological characteristics of attenders (143) and non-attenders (43) of antenatal classes at National Women’s Hospital, Auckland. Although over half the non-attenders were 'married Caucasian women aged 20-29 years' (Hutton et al. 1982:144), certain other groups were disproportionately represented among non-attenders. These were young (under 20), single, Maori, and Pacific Island women.

Risk approach

Two definitions of risk factors were given in the introduction. The risk approach is a strategy based on assessing risk factors for a particular outcome and usually totalling them in some way to come up with a person’s risk status. Assigning a risk status involves predicting an outcome and obviously some predictions will be wrong. These are referred to as false negatives and false positives. The table below, from Backett et al. (1984:30), explains this:

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Present +</th>
<th>Absent -</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present +</td>
<td>True Positives</td>
<td>False Negatives</td>
</tr>
<tr>
<td>Absent -</td>
<td>False Positives</td>
<td>True Negatives</td>
</tr>
</tbody>
</table>

Assessment systems try to reduce false negatives to a minimum as they are usually more serious than false positives. These women have the unwanted outcome and, for example, assigning a woman to low risk status who later had a LBW birth may have meant she did not receive the attention she should have.

Lumley, referring to preterm birth, has suggested that:

A risk assessment system which fails to predict most of the preterm births (many false negatives), can be made more sensitive by adjusting the cut-off point within the risk scoring system. Unfortunately, increasing the sensitivity in this way reduces the specificity (the capacity to identify correctly low risk women) at the same time. A higher proportion of all preterm births is predicted but at the cost of labelling more people as high risk, most of whom go on to have term infants (false positives)....

In addition, the predictive value of a screening system depends not only on its sensitivity and specificity but also on the incidence of the disorder within the population to whom the screening system is being applied. This property is not
PREVENTION STRATEGIES

intuitively obvious. If the same scoring systems were to be applied to populations with preterm birth rates of 12, 6 and 3%, the positive predictive value of the same high score would be 48, 30 and 17% respectively, and likewise 62, 70 and 83% of those designated high risk in the three populations would have term infants (1988a:102).

The cut-off point for determining high, medium or low risk, should reflect:

- available resources (e.g., there is no point in identifying 80% of individuals at high risk if there are no resources to do anything about it); and
- the ‘trade-off’ between false positives and false negatives:

  the question becomes one of how many more false positives can be ‘afforded’ by this community for the desired reduction in the number of false negatives? The answer will depend, of course, on a balance between the seriousness of the false negative mistakes and the damage done to individuals by the needless use of resources on false positives (Backett et al. 1984:38).

Scoring systems have been derived from retrospective analyses of pregnancy and birth datasets, with more or less sophisticated weighting of the factors found to be associated with the outcome under study. The risk assessment system is then applied to the dataset it was derived from to see how well it discriminates between those who have that outcome and those who do not. The next essential step is to validate the risk scoring system prospectively in a different population (Lumley 1988a).

Risk scoring methods will be discussed more fully in a later section. As will be seen in the next section, most prevention programmes have used a risk approach.

'Ecologic' approach

This is occasionally referred to in the literature, but as the term is used in different ways its use has been avoided in the rest of the paper. Chamberlin (1984) used it in a way that implies a population wide approach, at least in a defined geographical area. However, Olds’ use of an ecologic approach for his programme in a New York State county does not imply this: he meant a programme which focuses on the environmental conditions in which the family functions. In Olds’ study the nurses undertaking home visits were to try to minimise stressful family situations (Olds 1988). Most of the 400 women in his study were of ‘high risk’ status.

Chamberlin used the ecologic model as meaning that certain outcomes are related to parent functioning which is influenced by both formal and informal community support systems where ‘the focus is on the community as a whole and the relationships between families and their current environments’ (Chamberlin 1988:189-90). He believed a programme based on this approach would include, in addition to primary health care services, at least:

- a community council to establish priorities and co-ordinate services;
- a community wide health education programme;
- the availability of basic parent support centres;
• a consumer advocacy service; and
• a reliable assessment system (Chamberlin 1988:191-92).
Prevention programmes

Introduction

During the 1960s and early 1970s the United States Federal Government funded a number of demonstration programmes for poor, young pregnant women in an effort to improve pregnancy outcomes and early child rearing (Olds et al. 1986a). Most provided a greater range of services than previously but continued to be delivered from traditional clinic based settings.

In a number of countries, starting mainly in the 1970s, programmes aimed specifically at low birth weight and preterm birth prevention have operated, delivered through a variety of settings. These studies are discussed below and a summary table can be found in the Appendix. The studies are divided into two groups:

- those which aimed at preterm birth prevention and generally used enhanced medical interventions, such as more frequent cervical examinations, use of drugs, education on signs of preterm labour, and rest; and
- those which aimed at preventing LBW or a range of problems, and tended to use enhanced 'social' interventions, such as parenting guidance, nutrition and other health education, and social support.

Enhanced medical interventions

One of the earliest and most extensive programmes to date took place in France. In 1971 Emile Papiernik and colleagues instituted a programme in Haguenau, a city in Eastern France, and in 1973 at the Antoine Béclère Hospital in Paris. In 1977 they started a programme on the island of Martinique. All pregnant women were assessed as to their risk of a preterm birth by means of a risk scoring system developed by Papiernik, which is now used widely in France and Belgium. Papiernik no longer uses the scoring system in his daily obstetric practice, although staff are ‘acquainted’ with it and use it ‘under the appropriate circumstances’ (Papiernik 1984b:624).

For those at high risk, intervention efforts have concentrated on medical aspects (e.g., regular cervical examination) and on stress reducing activities (e.g., reducing physical activity and state-paid maternity leave six weeks prior to expected date of delivery). At different times during the programme, components have included home visits by midwives, a high rate of cervical cerclage (a surgical procedure involving insertion of a suture to prevent the cervix dilating – the suture is removed before delivery), prophylactic use of progestogens, and wide use of bed rest. Education on recognising symptoms of preterm labour was given and the women were informed of their personal risk characteristics.
The effects of the programme have been reported by using low birth weight (LBW) and preterm birth rates since the programme began:

<table>
<thead>
<tr>
<th>Year</th>
<th>LBW</th>
<th>Preterm rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971-74</td>
<td>4.6</td>
<td>5.4</td>
</tr>
<tr>
<td>1975-78</td>
<td>4.0</td>
<td>4.1</td>
</tr>
<tr>
<td>1979-82</td>
<td>3.8</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Haguenau 1971-74: 4.0, 4.1 decrease (statistically significant decrease)

Béclère Hospital
Clamart, Paris

<table>
<thead>
<tr>
<th>Year</th>
<th>Preterm rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>6.3</td>
</tr>
<tr>
<td>1976</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Source: Papiernik et al. (1985a, 1985b)

The best results in Haguenau were obtained with mothers of lower educational level. Reduction in preterm births was not observed where it was expected, in the major high risk categories. For example, there was no improvement for women with a previous preterm birth. The improvement was observed for women without any of these obstetric antecedents or complications (Papiernik et al. 1985b). At Béclère hospital positive results depended on early and regular attendance at prenatal clinics (Papiernik et al. 1985a).

While some of the decline may be attributable to the programme it is difficult to know how much. The preterm birth rate for France as a whole dropped from 8.2 percent in 1972 to 5.6 percent in 1981 (a 31.7% decrease). An information and education programme on prematurity was adopted for all of France during this time. This led Lumley (1988a:108) to suggest that 'changes in the whole population rather than in those receiving specific interventions seem to have been important' and that this implied:

- the attention of clinicians and policy makers might be directed to the more general elements of the programme: uptake of antenatal care; public education about occupational fatigue, travel or commuting; the physical stress involved in housework and child care; policy changes on earlier maternity leave or work reduction with income maintenance; home help provisions... [i.e., a population approach] (Lumley 1988a:109).

Main et al. (1985) undertook a study with 380 American black inner city women in 1983. An assessment was made of their risk status and the 132 'high risk' women were randomly assigned to special clinic care or control group (who received either routine care or 'high risk' care at the discretion of their physician, who was not informed of their risk status).

The high risk clinic women were seen weekly or bi-weekly and given a pelvic examination and education on the signs of preterm labour. A 24-hour telephone 'hot line' to medical care was also available. Cerclages were performed when indicated but prophylactic tocolytic (drugs used to inhibit premature labour) and progestin treatment was not used. The results for preterm birth and LBW for the high risk women were not significantly different:
These high rates, even among so-called low risk women, indicate that overall this was a high risk group. (The United States average LBW rate, for example, was 6.8% in 1981.) Emphasis on enhanced medical care does not appear to have been successful with this group, although fairly low numbers in the high risk group would make any small differences difficult to detect.

Herron et al. (1982) operated a programme similar to Main's mentioned above. The risk status of women at the University of California Hospital clinic was assessed - 176 were 'high risk' and 974 'low risk'. The high risk women attended a special weekly clinic where they were given a pelvic examination and education on the signs of preterm labour. The staff also received extra training, emphasising prompt response to patients, liberal and early admission for observation for increases in uterine activity, use of tocolytics for women in preterm labour, and awareness of contra-indications of long-term tocolysis.

There was no control group. The rate of preterm birth (high and low risk combined) was 2.4 percent compared to 6.75 percent at that hospital the year before the programme began. The rate at an affiliated institution was the same prior to the programme and remained at about 6.5 percent. While this appears to have been successful it is difficult to judge when there was no randomised control group.

Hobel and Bemis (1986) have also assessed risk status. Prenatal clinics (similar in terms of patient population and demographic characteristics) in the West Los Angeles area were randomly assigned to treatment or control status. Hobel met Papiernik prior to designing the programme and the interventions reflect this. The main focus was towards reducing stress and promoting the maintenance of pregnancy. Within the treatment clinics women of high risk status were randomly allocated to one of five interventions: (1) bed rest, (2) psychosocial support, (3) an oral progestin, (4) matched with a placebo, and (5) a control. All high risk women received education about preterm labour in addition to whatever 'treatment' they were assigned to receive while the control group received only education. (Presumably routine medical care was maintained.)

Only very preliminary results were reported, the treatment clinics being compared with the control clinics but no differentiation as to type of intervention. There appeared to be a statistically significant difference in the preterm rate in favour of the treatment clinics. However, caution is needed with preliminary results, as two other studies included in this paper were found to have quite different interim and final results.

Meis et al. (1987b) and Buescher et al. (1988) evaluated a large scale programme in North Carolina between July 1984 and July 1986. This involved all patients at all County Health Department clinics and at the clinics of some private physicians (n = 17370 births). Participation of physicians was voluntary, therefore those participating cannot be assumed to be representative of all providers in the region.
The women were assessed as to their risk status. Those at high risk made weekly visits and had cervical examinations. There was assessment of uterine activity of all women with signs of premature labour, with 'appropriate use of tocolytic agents' (Meis et al. 1987b:551). All women received education about premature labour and extra staff training was given for participating personnel. The staff training was on the importance of prompt evaluation of patients who may be in premature labour.

About 42 percent of all births in the region were to women in the project. Although the programme was aimed at prematurity prevention, most results presented are for LBW. Regional LBW rates showed a downward trend following the programme, although it is not possible to say if the programme was the cause of this:

<table>
<thead>
<tr>
<th>Year</th>
<th>Rate</th>
</tr>
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<tbody>
<tr>
<td>1980-84</td>
<td>7.48%</td>
</tr>
<tr>
<td>1986</td>
<td>6.70% (approximately)</td>
</tr>
</tbody>
</table>

The authors also compared 1985 rates for private patients in the project with private patients not in the project:

<table>
<thead>
<tr>
<th>Group</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>In project</td>
<td>5.87%</td>
</tr>
<tr>
<td>Not in project</td>
<td>7.34% (statistically significant)</td>
</tr>
</tbody>
</table>

Source: Meis et al. (1987b)

Although women not in the project were not entirely comparable, Buescher et al. (1988:265) have stated that 'after controlling for differences between the two groups... women out of the project [were] 1.32 times as likely as women in the project to have a birth less than 2500 grams (95% CI 1.14, 1.54)'.

Better results were experienced by the private patients than those receiving public prenatal care. Meis et al. commented that:

> the apparent success or lack of success of prematurity prevention programs is likely to be affected strongly by the characteristics of the patients in the program (1987b:555).

The above five studies all focused on enhanced medical care as the intervention and prevention of preterm birth as the aim. Four appear to have been successful and one (Main et al. 1987) does not. It is difficult to determine why this may be so. All used similar risk scoring methods and similar intervention techniques. Papiernik and Hobel and Bemis developed their own scoring systems. Meis based his on those developed by Creasy and Papiernik, and Herron and Main both used Creasy's system. Main, however, also carried out a retrospective analysis using her own risk scoring system developed from information obtained from the women. There appear to be two differences between Main's study and the others:

- All assessed the women’s risk status at their initial visit, but all but Main rescreened them at a later stage in their pregnancies. Main only screened at the initial visit: 'patients were not re-screened in the late second trimester so as not to draw attention to this study within the control clinics' (Main et al. 1987:62).
- Overall the population group in Main's study was in a much higher risk category than the populations of the other studies. (This can be seen from the LBW or preterm rates given – even the high risk groups in these studies have a lower rate than the low risk group in Main's study). In Papiernik's study,
reductions did not occur in the major high risk categories. One possible conclusion may be that these enhanced medical methods do not work with high risk populations. This is possibly because these methods may be better at reducing some causes of prematurity than others, and these causes of prematurity are more common in some types of population than in others (Meis et al. 1987a). This aspect is discussed more fully in the section on risk factors.

**Enhanced social interventions**

Beginning in 1978, David Olds initiated a programme in Elmira County, New York, using home visits by nurses. The general aim was to improve child health and development. Women less than 25 weeks pregnant were actively recruited into the programme if they had no previous live births and any one of three characteristics: (1) less than 19 years old, (2) single, and (3) low socio-economic status. However, the programme was open to any woman less than 25 weeks pregnant. Of the 400 women in the programme about 80 percent met at least one of the three criteria, and 23 percent met all three. Women were randomly assigned to four groups as shown in Table 1:

**TABLE 1: Services provided in each of the four treatment groups**

<table>
<thead>
<tr>
<th>Services provided</th>
<th>Treatment group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>n=90</td>
<td>n=94</td>
</tr>
<tr>
<td>n=100</td>
<td>n=116</td>
</tr>
<tr>
<td>Health and developmental screening at child's</td>
<td></td>
</tr>
<tr>
<td>12th and 24th month of life</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Free transportation to regular prenatal and well child visits</td>
<td>+</td>
</tr>
<tr>
<td>Nurse home visitation during pregnancy</td>
<td>+</td>
</tr>
<tr>
<td>Nurse home visitation during child's first two years of life</td>
<td>+</td>
</tr>
</tbody>
</table>

Source: Olds et al. (1986b:66)

The frequency of home visits was fairly high. Prior to each birth nurses made an average of nine visits to Groups 3 and 4 women. In Group 4 weekly visits were made in the first six weeks following birth; every second week until four months; every three weeks from 4 to 14 months; every four weeks from 14 to 20 months and every six weeks from 20 to 24 months. Visits lasted approximately one hour 15 minutes. The five nurses were specially selected and trained for this programme. They:

- provided a home based education programme focusing on factors that influence fetal and infant development and encouraged sound prenatal health habits and child rearing behaviours;
- systematically involved ‘significant others’ whom the mother wanted to have participate in the home visits; and
- linked families with other health and social services in the community (Olds 1982).
A number of assessments were made at different times on the women and children in the programme. Groups 1 and 2 were combined (there were no differences in outcomes between them) to form a comparison group. Some of the positive results reported were:

- an 'avoidance of restriction and punishment' test was administered in the children's 10th and 22nd months. In the poor, unmarried teenager subgroup, fewer Group 4 mothers restricted and punished their children than women in the comparison group (Olds et al. 1986b:72).

- Eight verified cases of abuse and/or neglect in the comparison group among poor unmarried teenagers and one in Group 4 in the same category. This was not statistically significant at the .05 level (p = .07) (Olds et al. 1986b:72).

- Fewer visits by children in Group 4 to the 'emergency room' during the first two years of life. In the first year this difference was because of a reduction in visits for upper respiratory tract infections. During the second year they also made fewer visits for accidents and poisonings (p < .05, statistically significant) (Olds et al. 1986b:75).

- Women in Groups 3 and 4 'made better use of the formal services that were available to them'; reported 'greater informal social support'; 'improved their diets more and reduced the number of cigarettes smoked' (Olds 1988:20).

- During the first two years postpartum the poor, unmarried women visited by the nurses had one-third as many subsequent pregnancies as their comparison group counterparts (Olds et al. 1988:1440).

However, the LBW rate for the treatment group (Groups 3 and 4 combined) was not improved (treatment = 5.78%; comparison = 2.61%, not statistically significant). The only improvement was in the 14 to 16 year old age group where there were no LBW babies among the 28 women in the treatment group compared to a rate of 11.76 percent among the 17 women in the comparison group (Olds et al. 1986a:24). While in percentage terms this looks impressive, 11.76 percent of 17 is only two people. The preterm delivery rate was improved only among smokers where there was a 75 percent reduction in the treatment group (Olds et al. 1986a:16). The preterm rate among the 78 treatment group smokers was 2.08 percent compared to 9.81 percent among the 64 comparison group women (p = .04). Among non-adolescent, non-smokers the results were totally unfavourable to the programme:

<table>
<thead>
<tr>
<th></th>
<th>LBW</th>
<th>Preterm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Treatment (n=71)</td>
<td>10.57</td>
<td>11.83</td>
</tr>
<tr>
<td>Control (n=72)</td>
<td>0.00</td>
<td>3.13</td>
</tr>
<tr>
<td>(p &lt; .01)</td>
<td>(p &lt; .05)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Olds et al. (1986a)

Olds' study is one of the few to use randomised controlled groups. While the programme components are described in detail, results are often not as clearly presented. The programme showed positive results in some areas of child health but not in others. As its aim was fairly general, the programme could be said to have been successful in meeting that aim, but would have been expensive to run in terms of staff resources.
Olds suggested that home visiting was more beneficial if begun during pregnancy to enable a rapport to be built up between the nurse and woman so that the new mother does not feel she is being criticised. Of course, if one of the aims of the programme is to prevent LBW or preterm birth, then the intervention will necessarily have to occur before birth. Larson (1980) designed a programme with the general aim of promoting better child health, to test whether home visiting was more beneficial if begun prior to birth. He concluded that it was (although it should be noted that the women involved received only one prenatal visit compared to ten postnatal visits).

Because women in lower socio-economic groups are at higher risk of a number of adverse pregnancy outcomes, many programmes have been aimed specifically at these groups. Two that have tried to reach them through methods other than traditional clinic settings have been reported by O'Brien and Anderson (1987) and Brooks-Gunn et al. (1988). O'Brien and Anderson's programme used a mobile van to provide prenatal health education to 41 women living in a public housing area. They compared them to 41 women matched on certain characteristics who delivered at the same hospital and who had not received the mobile clinic care (but who had all received some prenatal care). They found there were no differences in inpatient hospitalisation or obstetric problems.

Brooks-Gunn et al. detailed a project in Harlem, New York, which employed outreach workers to try to 'recruit' pregnant women who were not receiving any prenatal care. Four workers were employed for a year. One hundred women not receiving antenatal care were found, with 52 being enrolled in the programme. The authors concluded this was not a cost-effective use of resources. No results of the programme were reported.

Peoples and Siegel (1983) reported results of a North Carolina Maternity and Infant Care (MIC) project. This involved 5822 low income women. The project had an active outreach service, provided transportation, and followed up clinic non-attenders. Once registered the women received 'public health nursing, nutrition and social services, health education, and dental and medical care.' (Peoples and Siegel 1983:588). Overall the MIC services improved the participants' use of prenatal care but had no impact on LBW incidence (project = 11.5%; comparison = 8.9%). However, there were reductions in the LBW rate for those women characterised as high risk: 'in addition, the greater the number of high risk characteristics the greater the impact MIC appeared to have' (Peoples and Siegel 1983:601). For non-white teenagers the LBW rate for women in the project was 12.6 percent and in the comparison group 14.4 percent. The comparison group was black women from nearby counties although, however, the MIC women overall had a higher risk status.

Peoples et al. (1984) reviewed another project in North Carolina involving 648 black women. Services were similar but again there was no impact on LBW. For both of these evaluations difficulties were encountered finding a suitable comparison group.

Although there were some benefits from these two programmes, mainly in small subgroups, overall they were not successful. Unfortunately the description of the programme components was very general. Superficially they appear similar to a
number of programmes which have had more success, so it is impossible to say why these ones did not work.

Sokol et al. (1980) reported on a programme involving women at an obstetric clinic at Cleveland Metropolitan General Hospital or at one of five satellite clinics. Women who resided in designated underprivileged areas were included in the programme (n = 3307) and compared with women not residing in these areas, but using the same clinics and who were similar on a number of demographic characteristics, parity and marital status. The programme included routine antenatal care, health education, nutrition counselling, parenting guidance, home visits if needed, and free dental services. The preterm (less than 38 weeks) delivery rate was 21 percent lower, and LBW rate 16 percent lower in the programme group compared to the comparison group (these were statistically significant):

<table>
<thead>
<tr>
<th>Programme</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm rate</td>
<td>17.9</td>
</tr>
<tr>
<td>LBW</td>
<td>11.7</td>
</tr>
</tbody>
</table>

Source: Sokol et al. (1980)

The programme group women also had half the stillbirth rate and one-third the neonatal death rate of the comparison group women (Sokol 1980:154). This programme, with its emphasis on enhanced social support and education, seems to have been successful in reducing the LBW and preterm rates among these high risk women.

A project aimed at teenagers (83% of whom were non-white) was carried out in South Carolina from 1974 to 1978 (Piechnik and Corbett 1985). A multi-disciplinary team provided prenatal education, nutrition counselling and social work care, with nurse-midwives seeing the adolescents on each visit. Comparisons were made with under 18 year olds in the rest of the State receiving state funded prenatal care. Data were only available for 1976 to 1978 so, comparisons were made with the women in the project in these years (n = 490). Results were encouraging although they did not reach statistical significance:

<table>
<thead>
<tr>
<th>LBW Rate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Comparison</td>
</tr>
<tr>
<td>Total</td>
<td>9.2</td>
</tr>
<tr>
<td>Aged &lt;15</td>
<td>8.9</td>
</tr>
</tbody>
</table>

Source: Piechnik and Corbett (1985)

Felice et al. (1981) provided a special adolescent obstetric clinic attached to the University of Maryland Hospital. The teen clinic used a multi-disciplinary team providing obstetric, nutrition, social work and psychological care. The team had conferences at the end of the day to discuss each woman's visit. At least one home visit was made by the public health nurse and social worker. The 67 women (aged 15 or under of whom 93% were black) were matched for age, race, socio-economic status and parity with 67 women attending the same hospital's regular obstetric clinic. The LBW rate in the teen clinic adolescents was nine percent compared to 20.9 percent for the regular clinic. This does not quite reach statistical significance.
at the .05 level. However, using McNemar’s test, which focuses on the concept of matched pairs, the difference was significant at the .05 level. As participation in the teen clinic was voluntary there may be selection bias present as, for example, more highly motivated women may have attended the teen clinic.

Nutrition programmes for women, infants and children (WIC) began in the United States in 1972. Eligible participants receive a monthly set of food vouchers redeemable at local grocers for specific foods tailored to individual needs. Education on nutrition is also provided. In 1984 Kotelchuck et al. reported results of a state-wide evaluation of the Massachusetts WIC programme. The sample of 4126 included 95 percent of all eligible 1978 prenatal WIC participants. They were matched on age, race, parity, educational level and marital status, and as similar geographical location as possible, with 4126 Massachusetts women not receiving WIC services. However, the WIC population came from demographic groups at higher risk for poor pregnancy outcomes. This should be kept in mind because factors other than those matched may be important risk factors. Some of the results were:

- There was a 21 percent decrease in the incidence of LBW (WIC 6.9%, Control 8.7% \[p < .01\]);
- an improvement in the mean gestational age (WIC 40 weeks, Control 39.7 weeks \[p < .001\]); and
- a 44 percent decrease in the number of WIC women receiving inadequate care (based on an index measuring the number of visits and when prenatal care began):

<table>
<thead>
<tr>
<th>Number of prenatal visits</th>
<th>WIC</th>
<th>control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month prenatal care began</td>
<td>11.2</td>
<td>10.8</td>
</tr>
</tbody>
</table>

\[p < .001\]

Source: Kotelchuck et al. (1984)

The biggest improvements were seen in subgroups at highest risk, for example the mothers aged 15 and under had the largest pregnancy benefits and biggest decline in inadequate care, compared to the same aged women in the control group.

In New Zealand, Clark et al. (1986) operated a special antenatal clinic for adolescents (16 and under) at Middlemore Hospital, staffed by one nurse and doctor. Standard antenatal care was given as well as extra education and counselling. Self-responsibility was encouraged. The women were given the nurse’s home telephone number, and any who missed appointments were telephoned or visited at home by the nurse.

The 55 receiving special clinic care were compared to 55 of similar age and background seen at the ordinary clinic before the special clinic began. The authors report that:

- urinary tract infection, anaemia, premature labour, fetal distress, operative delivery, primary postpartum haemorrhage, low birth weight, infant admission rate to neonatal unit and artificial feeding were all significantly less common in the special clinic patients who also rarely missed appointments (Clark et al. 1986:59).
However:

as the number of clinic visits, investigations, inductions of labour and degrees of hospitalisation were similar in the two groups, medical intervention probably did not contribute to the reduced incidence of complications... [which] was probably associated in some way with the attention rather than the medical treatment (Clark et al. 1986:61).

More recently Spencer et al. (1989) have published results of a family worker project in Manchester, England. This project was a randomised controlled trial which had a sample size of 1227. Lay workers ('women... employed on the basis of personality and general life experience; they had no formal qualifications in the health or social services' [Spencer et al. 1989:272]) provided practical help about the home, psychological support, facilitation of access to existing services and encouragement to attend antenatal clinics. A total of 655 women were offered visits and only 40 percent of them accepted. On average, a full-time worker had six clients, each of whom received one to two visits per week. No significant differences were found between the experimental and control groups on LBW or preterm birth. The rates for both were about eight percent. The authors of the report concluded that:

Given the findings of the trial, it is apparent that simply providing a service and targeting it on a quarter of the population defined as at above average risk according to a mixture of broadly based criteria, will not affect the incidence of low birth weight in that population (Spencer et al. 1989:287).

A randomised controlled study in Perth, Australia offered home visits by midwives to high risk women. The midwives' focus was on providing social support to the 1970 participants. Ninety five percent of those women offered visits accepted. There was no significant effect of the intervention on preterm birth (OR 0.84, 95% CI 0.65-1.09) (Bryce 1989: pers comm). In the following table this study is classified as failure in a low rate area, although, from the limited data available to date, it may in fact be a 'medium' rate area.

The acceptance rates of these two studies may indicate that nurses or midwives are more acceptable as home visitors than lay people, although not necessarily any more effective.

In a review of social support literature Bryce et al. have commented:

Studies of the effects of social support interventions have rarely shown them to affect physical outcome.... Rather, the beneficial effects have been to increase the use of health services, improve compliance, and hasten recovery from illness. Like other intervention, social support has adverse effects and its potential for harm may equal its potential for benefit. Social support has been shown to create dependency and lower self-esteem in the recipients, and place stress on the providers (1988:20).

Summary

A number of studies have been reviewed here. Most were multi-component programmes, using either an 'enhanced medical' approach or routine medical care with enhanced social aspects. From the literature reviewed, most of the
programmes aimed at preterm birth prevention used enhanced medical interventions. It may be that preterm birth is more amenable to this type of intervention, such as through the use of tocolytic drugs. The next section, which discusses risk factors and risk-scoring methods, may help clarify this. Most of the studies using 'social' interventions were aimed at preventing LBW or a range of problems. Bryce’s Perth study appears to be the exception: it was aimed at preterm birth and used social support.

The studies differed as to the type of populations being monitored. For example, the study by Main et al. was undertaken with a black inner-city population where the preterm and LBW rates were very high compared to the national USA average, which is about six percent. As a rough guide, taking seven percent to eight percent as a cutoff point, the studies could be separated into those programmes which were (prior to the programme commencing) operating in areas that had comparatively low rates, and those which had high rates.

An attempt will also be made to categorise the studies as ‘successes’ and ‘failures’ in terms of whether they achieved their aims. However, this should be treated with caution as some of the results are mixed, (e.g., Olds’ study) and many studies had no control group or had difficulty finding an appropriate comparison group. There is also the possibility that some of the positive impact may have resulted from the so-called Hawthorne effect. This is a positive effect which 'results entirely from the process of being studied and of being the subject of interest, excitement and report, rather than from the interventions of the programme itself' (Backett et al. 1984:74). This is certainly indicated in the New Zealand study by Clark et al.

The table below summarises the programmes on the basis of their aims, whether they were successful or not, and whether they operated in an area that had a high or low LBW/preterm rate.

<table>
<thead>
<tr>
<th>PREVENTION AIM</th>
<th>LBW (or range of aims)</th>
<th>PRETERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low rate area</td>
<td>Success</td>
<td>Failure</td>
</tr>
<tr>
<td>Olds et al. 1</td>
<td>Spencer et al.</td>
<td></td>
</tr>
<tr>
<td>High rate area</td>
<td>Sokol et al.</td>
<td>Peoples and</td>
</tr>
<tr>
<td>Felice et al.</td>
<td>Piechnick and Corbett</td>
<td></td>
</tr>
<tr>
<td>Piechnick and Corbett</td>
<td>Peoples et al.</td>
<td></td>
</tr>
<tr>
<td>Clark et al.</td>
<td></td>
<td>Meis et al.</td>
</tr>
</tbody>
</table>

1. NB: Overall the LBW rate for the treatment and control groups was low, but this masks higher rates among certain subgroups.

There is no clear evidence of what type of intervention is most effective. Very few studies have attempted to determine which components of a programme may be successful, and with whom. Admittedly the focus of this paper has been on multi-component programmes. There is some single-component literature, for example
on nutrition and smoking cessation interventions. Nevertheless, reviews of
literature by Lumley (1987) and Oakley (1985) seemed to indicate that these
programmes have also had mixed results, with some successes and some failures.
Furthermore, Oakley has reported that the design of many nutrition studies makes
it impossible to attribute the outcome specifically to changes in pregnant women’s
diet (1985:1265). Lumley has commented that ‘A common problem with
behavioural and social interventions in medicine is that they are too poorly defined
or too weak to be effective’ (1988b:23).

If a programme is to be implemented in New Zealand the following are some
broad conclusions from this part of the review:

When considering what intervention methods to use, the first consideration
should be what the programme is going to attempt to prevent. Hobel and Bemis
originally developed a risk scoring system aimed at identifying pregnancies at risk
for neonatal morbidity and mortality. As they report, their experiences with this
approach over four years:

helped us to recognize that our global approach to risk assessment needed to be
redefined and directed toward identifying patients at risk for specific problems,
such as preterm birth, intrauterine growth retardation and birth defects (1986:206).

Generally, enhanced medical methods have been used when preterm birth
prevention has been the aim, and an enhanced social approach has been when
prevention of LBW or a range of outcomes have been the aim. This may be just
coincidental for the studies reviewed, or it may be that these methods are more
appropriate to these aims.

One of the problems with having broad aims and using a range of interventions
is that it is impossible to say what methods were the most effective and efficient in
producing the results, or whether the programme was successful or not. Olds’
study, for example, failed to reduce the LBW rate while succeeding on some other
outcomes. There are no clues as to why it failed on the LBW measure, or why it
was particularly unsuccessful on LBW and PD prevention with non-smokers.

Most of the programmes operating in areas of high LBW/PD rates used social
interventions, with mixed success. Tentatively this suggests that a New Zealand
programme aimed at LBW prevention in a high risk group should try these
methods. As to which components of the social intervention approach may be more
successful than others, it is impossible to say from these studies. Also it is possible
that the increased attention given to the study participants may be the important
factor. Ideally some randomised trials using different interventions should be used,
although, given the small size of the population, this would be very difficult in New
Zealand.
Risk factors and risk assessment

Risk factors

In this section literature that has looked at determinants of LBW and risk factors is reviewed, as well as some risk scoring systems used in this field.

Kramer (1987b) undertook a meta-analysis of 895 articles to find the determinants of LBW. He assessed the determinants of intrauterine growth and prematurity separately, although he did not look at factors of extremely low prevalence or at medical complications of pregnancy. The factors he found that determined intrauterine growth and prematurity in developed countries were:

### INTRAUTERINE GROWTH

**Direct**
- Sex of infant
- Racial/ethnic origin
- Maternal height
- Pre-pregnancy weight
- Paternal height and weight
- Maternal birth weight
- Parity
- Prior LBW infant
- Gestational weight gain
- Caloric intake
- General morbidity
- Malaria
- Cigarette smoking/Tobacco chewing
- Alcohol consumption

**Indirect**
- Maternal age
- Socio-economic status

### PREMATURITY

**Direct**
- Pre-pregnancy weight
- Prior prematurity
- Prior spontaneous abortion
- In utero diethylstilbestrol (DES) exposure
- Cigarette smoking

**Indirect**
- Maternal age
- Socio-economic status

1. This refers to the mother being exposed during her mother’s pregnancy, i.e., in utero.
2. ‘Those whose effects are expressed through one or more of the direct factors’ (Kramer 1987a:505).

Source: Kramer (1987a)

Kramer presents pie charts showing the relative importance of each of these factors: cigarette smoking is the biggest single component (about 35%) of IUGR, while about 65 percent of the ‘factors with direct causal impacts’ on prematurity are unknown (Kramer 1987a). He states that in developed countries most LBW babies are premature rather than growth retarded, which is the opposite of developing...
countries. Other studies suggest that up to one-third of LBW can be caused by IUGR (Bragonier et al. 1984, Meis et al. 1987a).

The actual cause of the LBW is important. For example an infant who is IUGR as a result of an intrauterine rubella infection will have a much poorer prognosis than another of similar weight who is small because its mother is short (Kramer 1987b:664). Also, although baby girls are significantly smaller than boys, they have lower neonatal mortality and lower incidence rates for many infant and childhood diseases.

From his study, Kramer (1987b:723) suggested the following as public health interventions:

*Intrauterine growth*
- anti-smoking efforts;
- selective caloric supplementation before and during pregnancy;
- delayed child-bearing in young adolescents;
- improved maternal education;
- selective improvements in nutrition;
- selective improvements in socio-economic conditions; and
- new vaccines to prevent communicable diseases.

*Gestational duration*
- anti-smoking efforts;
- selective caloric supplementation before pregnancy;
- delayed child-bearing in adolescents;
- improved maternal education; and
- selective improvements in socio-economic conditions.

Kramer has highlighted the importance of looking at risk factors for IUGR and prematurity separately, and also that many of the causes of prematurity are unknown. Meis et al. (1987a) examined reasons for LBW in two North Carolina populations – those receiving publicly funded prenatal care and those receiving private prenatal care. The reasons for LBW were classified as:
- LBW but born after 37 weeks gestation (IUGR);
- medical problems, for example pyelonephritis, placenta abruptio, severe preeclampsia;
- premature rupture of the membranes, less than 37 weeks gestation; and
- idiopathic prematurity (cause unknown).

The researchers found the reasons varied in the two populations:

<table>
<thead>
<tr>
<th>LBW Babies</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBW full term</td>
<td>26.7</td>
<td>13.8</td>
</tr>
<tr>
<td>Medical problems</td>
<td>14.9</td>
<td>16.1</td>
</tr>
<tr>
<td>Premature rupture</td>
<td>33.7</td>
<td>23.0</td>
</tr>
<tr>
<td>Idiopathic prematurity</td>
<td>24.8</td>
<td>47.1</td>
</tr>
</tbody>
</table>
The results were even more divergent for the subgroup of very low birth weight babies:

<table>
<thead>
<tr>
<th></th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBW full term</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Medical problems</td>
<td>26.8</td>
<td>22.7</td>
</tr>
<tr>
<td>Premature rupture</td>
<td>39.0</td>
<td>18.2</td>
</tr>
<tr>
<td>Idiopathic prematurity</td>
<td>34.2</td>
<td>59.1</td>
</tr>
</tbody>
</table>

Source: Meis et al. (1987a)

Since many strategies are aimed at preventing idiopathic prematurity this may help explain why some succeed and some do not, for example the study by Main et al. (reviewed in the last section) was conducted largely with women receiving public prenatal care.

These data suggest that reports of success or lack of success of prematurity prevention programs should be evaluated in the context of the characteristics of the patient population involved (Meis et al. 1987a:1168).

The data also lead the authors to say that although the LBW rate tends to be lower in private patient groups, these populations might well benefit from the current prematurity prevention techniques, and that:

> the development of more effective programs for prevention of prematurity in public patients is likely to depend on developing an effective strategy or combination of strategies for reducing the number of LBW births related to premature rupture of the membranes (Meis et al. 1987a:1168).

Ross et al. (1986), believing the relative importance of specific risk factors may depend on the populations studied, have developed a prematurity risk scoring system for a predominantly Hispanic American population.

The United States Institute of Medicine Committee to Study the Prevention of Low Birthweight (1985:7) summarised the current thinking on the principal risk factors in America for LBW:

**Demographic risks**
- Age (less than 17 or over 34)
- Race (black)
- Low socio-economic status
- Unmarried
- Low level of education

**Medical risks pre-dating pregnancy**
- Parity (0 or more than 4)
- Low weight for height
- Genitourinary anomalies/surgery
• Selected diseases such as diabetes, chronic hypertension
• Non-immune status for selected infections such as rubella
• Poor obstetric history, including previous LBW infant, multiple spontaneous abortions
• Maternal genetic factors, such as low maternal weight at own birth

Medical risks in current pregnancy
• Multiple pregnancy
• Poor weight gain
• Short inter-pregnancy interval
• Hypotension
• Hypertension/preeclampsia/toxemia
• Selected infections such as symptomatic bacteriuria, rubella and cytomegalovirus
• First or second trimester bleeding
• Placental problems such as placenta previa, abruptio placentae
• Hyperemesis
• Oligohydramnios/polyhydramnios
• Anemia/abnormal hemoglobin
• Isoimmunisation
• Fetal anomalies
• Incompetent cervix
• Spontaneous premature rupture of the membranes

Behavioural and environmental risks
• Smoking
• Poor nutritional status
• Alcohol and other substance abuse
• DES exposure and other toxic exposures, including occupational hazards
• High altitude

Health care risks
• Absent or inadequate prenatal care
• Iatrogenic prematurity

Evolving concepts of risk
• Stress, physical and psychosocial
• Uterine irritability
• Events triggering uterine contractions
• Cervical changes detected before onset of labour
• Selected infections such as chlamydia trachomatis
• Inadequate plasma volume expansion
• Progesterone deficiency
In considering maternal age a number of studies have found that it has little independent effect on birth weight when other risk factors are controlled for (McAnarney 1987; Kramer 1987b; Zuckerman et al. 1983).

McAnarney reviewed the literature on factors related to adolescent pregnancy and LBW. She found that early and consistent prenatal care is associated with a lower incidence of LBW among adolescents, particularly the very youngest, who are at highest risk, but that it was not clear to what extent prenatal care per se exerts a positive effect on neonatal outcome. A specific relationship between maternal emotional stress and LBW was not strong: 'Stress may have a direct adverse effect on birth weight or may be mediated through adverse health habits' (McAnarney 1987:1056). However, Bragonier et al. (1984) believed that stress plays the most important role in increasing the risk of preterm labour (this is not specifically referring to adolescents).

There are also differences of opinion on the role of physical work. Papiernik found a close relationship between heavy physical work and preterm birth (Papiernik 1984a:326). However, Ernest et al. (1988) did not find heavy physical or stressful work to be a risk factor. Hoffman and Bakketeig (1984), using Norwegian data from 1967 to 1976, found higher risks associated with clerical or sales, service and manufacturing occupations, intermediate risks for technical and professional occupations, and low risks for housewife, unemployed and those engaged in agriculture and fishing.

The factors Ernest et al. (1988) found most associated with premature LBW were: less than one year since last birth; previous premature or LBW birth; two or more previous stillbirths or neonatal deaths; uterine anomaly (except myoma); or DES exposure and a history of placenta praevia. Most of these factors are not applicable to a first birth, and the risk of LBW declines with increasing parity. This difficulty of predicting LBW for primigravid women is one of the criticisms of risk scoring systems.

Risk assessment

Helfer (1987) believed there are three main methods for assessing risk status: self-administered questionnaire, standardised interview and observational check-list. He gives examples of usage of all three methods, although it seems the standardised interview has been used most extensively.

Papiernik was the first to report on a method of identifying the risk for preterm labour and he also identified factors in all areas now considered important, such as general and social factors and medical antecedents (Bragonier et al. 1984). Creasy et al. (1980) modified Papiernik's scoring system, prospectively testing it in a New Zealand population. This is widely quoted in the literature and is reproduced below.
# Preventing Low Birth Weight and Preterm Birth

## Risk Scoring System for Preterm Delivery

<table>
<thead>
<tr>
<th>Points</th>
<th>Socio-economic</th>
<th>Past History</th>
<th>Daily Habits</th>
<th>Current Pregnancy</th>
</tr>
</thead>
</table>
| 1      | Two children at home (Low SES)
         | 1 abortion     | Work outside the home | Unusual fatigue |
| 2      | <20 years >40 years (Single) | 2 abortions >10 cigarettes per day | <13 kg weight gain by 32 weeks gestation |
| 3      | Very low SES <150cm tall <45kg | 3 abortions | Heavy work Long, tiring trip to work |
| 4      | <18 years | Pyelonephritis | | |
| 5      | Uterine anomaly Second trimester abortion DES exposure | | Breech at 32 weeks Weight loss 2 kg |
| 10     | Premature delivery Repeated second trimester abortion | | Twins Abdominal surgery |

Score: 10 or more = high risk, 6-9 = medium risk, <6 = low risk

1. SES = socio-economic status.

Source: Creasy et al. (1980:693).

In the New Zealand study, the incidence of preterm delivery in the low, medium, and high risk groups was two percent, five percent and 30 percent respectively. The high risk group comprised 13 percent of all women in the sample and accounted for 64 percent of all preterm deliveries (or 69% of all preterm labours). The scoring test was not as good at predicting preterm births for women who were having their first baby (primigravidas). The high risk primigravid group (9% of all primigravid women) contributed only 31 percent of all primigravid preterm births. Reassignment of risk status for all women at 26 to 28 weeks improved the overall prediction power from 44 percent to 64 percent (Creasy et al. 1980).

This adds to the suggestion in the previous section that the study by Main et al., which used the same risk scoring system, probably failed to work because it operated in a different type of population and did not re-screen the women. While there seems to be definite benefits to re-screening, this could be problematic, as Main et al. believed to have re-screened would have drawn more attention to the study.
among the control group thus possibly biasing the results.

In the study by Main et al. (1987) there were no significant differences in outcome between high risk and low risk women. The 21 percent of women who were high risk experienced 25 percent of the preterm births. The screening system did not perform differently for nulliparous or multiparous women, contrary to the study by Creasy et al. This study also tested the screening system using different cut-off points (8, 10 or 15) and, finally, attempted to devise their own risk scoring system using additional information obtained at the registration interview. Neither of these produced significant results.

Main et al. have stated that:

The failure of this screening program in poor inner city women is in contrast to its apparent success in a larger population in New Zealand, which had a lower rate of preterm birth. Its efficacy in New Zealand may have been due to its ability to distinguish between socioeconomic classes rather than to the predictive value of the factors themselves. Alternatively, in a black, indigent population, such predictive factors may prove to be overwhelmed by stronger but as yet unidentified factors specific to this indigent population (1987:65).

**Parenting dysfunction**

In addition to prematurity risk scoring systems, some literature was read on more general scoring systems, usually relating to ‘parenting dysfunction’. As many of these use postnatal interventions, they were largely regarded as outside the scope of this review and therefore not collected systematically. However, some description will be given of those collected, including a New Zealand study.

Larson et al. developed an assessment system involving prenatal and postnatal assessments to ‘identify families who will demonstrate high levels of parental dysfunction at six months postpartum’ (1987:188). The assessments involved a telephone interview prenatally (at seven months) which rated the mother’s education level, whether she had attended a prenatal course, and her present smoking habits. Another telephone interview a few weeks after birth included extra questions on the mother’s age, any problems while in hospital, breastfeeding habits and any sleeping problems of the baby. Other assessments included home observations at six weeks and six months postpartum. The sample was divided into two subgroups: one provided the data for the development of the tests and the other was used to validate the tests and determine optimum cutoff points.

Avison et al. (1986) also attempted to develop a screening test to predict ‘women who may be at elevated risk for problems in parenting,’ particularly child abuse and neglect. Various tests were used to measure social support, stressful life events, feelings of personal control and self-esteem, and parenting attitudes and perceptions. After testing their system on samples of known ‘maladaptors’, Avison et al. came up with a 20-item scale of the best predictors. This was tested in another sample of known ‘maladaptors’ and comparison mothers, and accurately predicted about 90 percent of each. However, a major weakness was the fact that very small changes in raw scores could produce sizeable variations in the accuracy of the
resulting classification. Both Avison's and Larson's studies were conducted in Canada.

An English postnatal intervention programme aimed at preventing child abuse used a list of 'predictors'. Children were considered at risk if at least three factors (at least one of which had to be a major factor) were present.

Major factors were:
- mother under 20 years at birth of first born;
- mother booked at antenatal clinic after 20 weeks; and
- mother other than married at delivery of child.

The minor factors were:
- step-children in the family;
- psychiatric history;
- previous referral to social worker;
- termination of pregnancy requested but refused;
- complications of pregnancy or delivery;
- baby admitted to special care baby unit; and
- mother took own or infant’s discharge against advice.

The intervention for the high risk group was visits (number unspecified) by a social worker and provision of a ‘drop in’ centre, staffed by a nurse (health visitor), one day a week. While two-thirds of the recognised abuse occurred in the 18 percent at high risk:

- the rate of serious injury to their children was no higher than that in the not at risk group... the social worker felt that he had intervened successfully to prevent escalation of family conflicts, but we have no statistical evidence to support the views that intervention improved parenting practice (Lealman et al. 1983:1424).

In Dunedin a risk scoring system for predicting future parenting problems has been developed over a number of years (Clarkson et al. 1988, Monaghan et al. 1986). A nine item questionnaire is administered:

Criteria for determining risk

1. Mother has had frequent changes of address in the year before delivery (more than two changes of address in the previous 12 months).
2. Mother has had past or present psychiatric treatment.
3. Likely incompetence of mother as a parent because of apparent emotional problems (assessed by a multi-disciplinary team on such factors as refusal of psychiatric treatment and/or observation of mother's behaviour by hospital staff).
4. Likely incompetence of mother as a parent because of apparent lack of intellectual ability (assessed by a multi-disciplinary team on such factors as school record, ability to follow simple instructions about children).
5. Mother has unrealistic expectations of the new child (from answer to a brief questionnaire asking the mother to predict the baby's behaviour and its consequences for her).
6. Mother refused (or dropped out of) prenatal classes.
7. Mother changed her decision regarding adoption of the child.
8. A previous child was abused or neglected.
9. Mother suffered parental violence or neglect as a child.

Four or more ‘yes’ responses constitute ‘A’ risk = high; three = ‘B’ = moderate risk; two = ‘C’ = low risk; and one or none = ‘D’ = no risk.

Source: Clarkson et al. (1988)

The system has been tested and found to correctly predict 'parenting failure' with a 93 percent sensitivity and an 81 percent specificity. A number of factors were used to measure parenting failure.

The assessment was done at the time the woman enrolled for later delivery at the hospital, and again when she was discharged (Monaghan et al. 1986:372). It appears the interventions take place after birth. They included:

- the Acorn Club which functions as a weekly parent support group maintained by medical social workers, weekly pediatric support meetings where health care professionals from the hospital and the community co-ordinate their efforts, and the Plunket family units. Other new interventions included referral to the child protection team... and the services of volunteers trained by the social welfare agencies (Clarkson et al. 1988:12).

Problems and cautions

A number of authors mention factors to remember when considering risk scoring systems. For prematurity scoring methods, Lumley (1988a) points out their poor validity for primigravid women. (In Australia, primigravidas account for one-third of all pregnant women.)

Developing and testing the system in the target population is important, as the results of Creasy’s and Main’s usage of the same system showed. When validating a risk scoring system Main et al. believed it would be misleading if the individuals were informed of their risk status, as is usual in many of these programmes. ‘Identifying a patient as high risk and then not providing special care for her could increase stress and alter pregnancy outcome’ (1987:65). On the other hand, the woman may experience an improved outcome simply resulting from her identification with a special programme (Hawthorne effect).

Lumley has suggested that the process of risk assessment promotes intervention, noting that ‘a French study reported the trebling of prophylactic cervical suture after the introduction of risk assessment’ (Lumley 1988a:103). She also believed regular pelvic examinations to evaluate the cervix can cause problems and may not be very useful anyway, arguing that ‘the positive predictive value of cervical changes for preterm labour can be calculated at 14 percent to 28 percent’ (Lumley 1988a:103).

Helfer, quoting Bristor, Helfer and Wilson, has stated that:

The utilisation of instruments with so-called predictive capability on a 'routine' basis carries considerable concern. At best, these have an 80 to 85 percent
sensitivity and specificity. One must use great care not to adversely label or make invasive intervention decisions solely on the results of these tests. Their use in clinical decision making mandates that services be available for referral and follow-up for those in need of them (Helfer 1987:574).
**New Zealand statistics**

**Births**

In 1986 5.7 percent of all births were of low birth weight (<2500 grams) and 0.9 percent of very low birth weight (<1500 grams). The percentage rate varies with ethnicity: 8.3 percent for Maori and 4.4 percent for Pacific Islander. Percentages also vary among health districts, from a low of 3.3 percent in Greymouth to a high of seven percent in Wanganui. Table 2 lists the percentage of live births under 2500 grams and under 1500 grams by health district and by ethnicity (Maori, non-Maori and total population).

**TABLE 2: LBW births as a percentage of live births in 1986, by Health District**

<table>
<thead>
<tr>
<th>Health District</th>
<th>Maori &lt;1500g</th>
<th>Maori &lt;2500g</th>
<th>Non-Maori &lt;1500g</th>
<th>Non-Maori &lt;2500g</th>
<th>Total &lt;1500g</th>
<th>Total &lt;2500g</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand</td>
<td>1.0</td>
<td>8.3</td>
<td>0.9</td>
<td>5.4</td>
<td>0.9</td>
<td>5.7</td>
</tr>
<tr>
<td>Northland AHB</td>
<td>0.6</td>
<td>7.4</td>
<td>0.4</td>
<td>4.1</td>
<td>0.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Takapuna</td>
<td>1.6</td>
<td>10.1</td>
<td>1.0</td>
<td>5.5</td>
<td>1.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Auckland</td>
<td>0.2</td>
<td>7.1</td>
<td>1.0</td>
<td>5.7</td>
<td>0.9</td>
<td>5.9</td>
</tr>
<tr>
<td>South Auckland</td>
<td>1.6</td>
<td>9.2</td>
<td>1.0</td>
<td>6.0</td>
<td>1.1</td>
<td>6.6</td>
</tr>
<tr>
<td>Hamilton</td>
<td>0.7</td>
<td>8.8</td>
<td>0.8</td>
<td>4.9</td>
<td>0.8</td>
<td>5.6</td>
</tr>
<tr>
<td>Rotorua</td>
<td>0.9</td>
<td>7.0</td>
<td>0.5</td>
<td>4.6</td>
<td>0.6</td>
<td>5.2</td>
</tr>
<tr>
<td>Gisborne</td>
<td>0.2</td>
<td>6.2</td>
<td>1.6</td>
<td>6.2</td>
<td>1.1</td>
<td>6.2</td>
</tr>
<tr>
<td>Napier</td>
<td>2.3</td>
<td>9.7</td>
<td>1.0</td>
<td>5.3</td>
<td>1.1</td>
<td>5.9</td>
</tr>
<tr>
<td>New Plymouth</td>
<td>0.7</td>
<td>8.5</td>
<td>1.1</td>
<td>6.0</td>
<td>1.2</td>
<td>6.4</td>
</tr>
<tr>
<td>Wanganui AHB</td>
<td>1.6</td>
<td>11.6</td>
<td>0.8</td>
<td>6.0</td>
<td>0.9</td>
<td>7.0</td>
</tr>
<tr>
<td>Palmerston Nth</td>
<td>-</td>
<td>7.7</td>
<td>1.1</td>
<td>5.4</td>
<td>0.9</td>
<td>5.5</td>
</tr>
<tr>
<td>Hutt</td>
<td>1.6</td>
<td>7.8</td>
<td>0.7</td>
<td>5.7</td>
<td>0.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Wellington</td>
<td>0.8</td>
<td>8.4</td>
<td>0.9</td>
<td>4.8</td>
<td>0.9</td>
<td>5.2</td>
</tr>
<tr>
<td>Nelson AHB</td>
<td>-</td>
<td>9.6</td>
<td>0.3</td>
<td>4.4</td>
<td>0.3</td>
<td>4.4</td>
</tr>
<tr>
<td>Greymouth</td>
<td>-</td>
<td>6.7</td>
<td>0.2</td>
<td>3.2</td>
<td>0.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Christchurch</td>
<td>0.7</td>
<td>6.0</td>
<td>0.9</td>
<td>5.8</td>
<td>0.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Timaru</td>
<td>-</td>
<td>5.6</td>
<td>0.7</td>
<td>4.5</td>
<td>0.7</td>
<td>4.6</td>
</tr>
<tr>
<td>Dunedin</td>
<td>-</td>
<td>10.0</td>
<td>0.5</td>
<td>5.8</td>
<td>0.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Invercargill</td>
<td>1.2</td>
<td>9.4</td>
<td>0.7</td>
<td>4.1</td>
<td>0.7</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Source: National Health Statistics Centre (1988)

From Table 2 it can be seen that those districts above the New Zealand average for all three categories are South Auckland, New Plymouth, Wanganui AHB and

[29]
Dunedin. Districts below the New Zealand average in all three are Northland, Rotorua, Palmerston North, Greymouth and Timaru (1986 data).

The percentage of LBW births has increased slightly over the 11 years from 1976 to 1986, as Table 3 shows:

**TABLE 3: LBW births as a percentage of live births from 1976 to 1986**

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt;1500g</th>
<th>&lt;2500g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>0.54</td>
<td>5.0</td>
</tr>
<tr>
<td>1977</td>
<td>0.58</td>
<td>5.0</td>
</tr>
<tr>
<td>1978</td>
<td>0.65</td>
<td>5.2</td>
</tr>
<tr>
<td>1979</td>
<td>0.60</td>
<td>5.1</td>
</tr>
<tr>
<td>1980</td>
<td>0.65</td>
<td>5.2</td>
</tr>
<tr>
<td>1981</td>
<td>0.64</td>
<td>5.4</td>
</tr>
<tr>
<td>1982</td>
<td>0.63</td>
<td>5.2</td>
</tr>
<tr>
<td>1983</td>
<td>0.77</td>
<td>5.4</td>
</tr>
<tr>
<td>1984</td>
<td>0.75</td>
<td>5.3</td>
</tr>
<tr>
<td>1985</td>
<td>0.81</td>
<td>5.5</td>
</tr>
<tr>
<td>1986</td>
<td>0.90</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Source: National Health Statistics Centre (1987, 1988)

The relative risks of having a LBW birth for four characteristics (based on 1981-83 data) are:

<table>
<thead>
<tr>
<th>Maternal age</th>
<th>Relative risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;19</td>
<td>1.40</td>
</tr>
<tr>
<td>20-24</td>
<td>1.00</td>
</tr>
<tr>
<td>25-29</td>
<td>0.83</td>
</tr>
<tr>
<td>30-34</td>
<td>0.79</td>
</tr>
<tr>
<td>35-39</td>
<td>0.93</td>
</tr>
<tr>
<td>40+</td>
<td>1.19</td>
</tr>
</tbody>
</table>

**Number of previous issue**

<table>
<thead>
<tr>
<th>Previous issue</th>
<th>Relative risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.00</td>
</tr>
<tr>
<td>1</td>
<td>0.71</td>
</tr>
<tr>
<td>2</td>
<td>0.68</td>
</tr>
<tr>
<td>3</td>
<td>0.67</td>
</tr>
<tr>
<td>4+</td>
<td>0.90</td>
</tr>
</tbody>
</table>
**Mother's ethnicity**

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Maori</td>
<td>1.00</td>
</tr>
<tr>
<td>Maori</td>
<td>1.59</td>
</tr>
<tr>
<td>Pacific Island</td>
<td>0.80</td>
</tr>
</tbody>
</table>

**Marital status**

<table>
<thead>
<tr>
<th>Status</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuptial</td>
<td>1.00</td>
</tr>
<tr>
<td>Ex-nuptial</td>
<td>1.61</td>
</tr>
</tbody>
</table>

Source: National Health Statistics Centre, unpublished data

This information highlights three ‘risk factors’, that is age (under 19), ethnicity (Maori) and marital status (single).

**Deaths**

LBW babies account for a disproportionate number of infant deaths. Table 4 shows the percentage of neonatal and post-neonatal deaths which were of LBW babies.

**TABLE 4: LBW babies as a percentage of total neonatal and post-neonatal deaths, 1986**

<table>
<thead>
<tr>
<th></th>
<th>Maori</th>
<th>Non-Maori</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;1500g</td>
<td>&lt;2500g</td>
<td>&lt;1500g</td>
</tr>
<tr>
<td>Neonatal deaths</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>(liveborn to 28 days)</td>
<td>46.0</td>
<td>56.0</td>
<td>41.0</td>
</tr>
<tr>
<td>Post-neonatal deaths (28th day to 1 year)</td>
<td>n/a</td>
<td>14.3</td>
<td>n/a</td>
</tr>
</tbody>
</table>

1. n/a = not available in published form

Source: National Health Statistics Centre (1988)

While 5.7 percent of all births are of LBW, they comprise 56 percent of neonatal deaths. The disparity is even greater for very low birth weight babies, that is 0.9 percent of all births are less than 1500 grams but they comprise 42 percent of neonatal deaths. As some overseas studies have noted, an improvement in the VLBW rate could have a marked effect on the neonatal death rate.
Conclusion

The studies reviewed here contain a mixture of 'successes' and 'failures'. The successes have reported decreases in LBW and/or preterm rates ranging from about 15 percent to over 40 percent. Bryce and Stanley concluded their appraisal of prematurity prevention programmes with the following comment:

Although appealing, the effectiveness of programs aimed at prevention of preterm birth is not yet proven. Should such programs be proven to be effective in randomised controlled clinical trials, their cost-effectiveness is virtually assured, given the high cost of care for preterm infants (1985:38).

The United States Institute of Medicine Committee to Study the Prevention of Low Birthweight looked at potential cost savings of prenatal care. It estimated that if current prenatal care could be provided to all disadvantaged women and a 20 percent reduction in the LBW rate was achieved, for each $1 spent on the prenatal care, expenditure on medical care for LBW babies could be reduced by $3.38 (Kuhse et al. 1988, Behrman 1985). Kuhse et al. (1988) stated that the cost in Australia of intensive care for very LBW babies has been calculated at $600 per day, and higher for those requiring ventilation.

To get some idea of the potential application in New Zealand of a successful programme, the following table shows a 25 percent reduction in the LBW rate by health districts based on 1986 data. Twenty-five percent was chosen as an approximate average from the results of studies by Papiernik, Hobel and Bemis, Meis, Sokol, Piechnik and Corbett, and Kotelchuck.

**TABLE 5: New Zealand total population: LBW births, 1986**

<table>
<thead>
<tr>
<th>Health District</th>
<th>Number of LBW (&lt;2500g) births</th>
<th>25% reduction on number of LBW births</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northland AHB</td>
<td>110</td>
<td>82</td>
</tr>
<tr>
<td>Takapuna</td>
<td>263</td>
<td>197</td>
</tr>
<tr>
<td>Auckland</td>
<td>257</td>
<td>193</td>
</tr>
<tr>
<td>South Auckland</td>
<td>350</td>
<td>262</td>
</tr>
<tr>
<td>Hamilton</td>
<td>293</td>
<td>220</td>
</tr>
<tr>
<td>Rotorua</td>
<td>194</td>
<td>145</td>
</tr>
<tr>
<td>Gisborne</td>
<td>79</td>
<td>59</td>
</tr>
<tr>
<td>Napier</td>
<td>129</td>
<td>97</td>
</tr>
<tr>
<td>New Plymouth</td>
<td>111</td>
<td>83</td>
</tr>
<tr>
<td>Wanganui AHB</td>
<td>97</td>
<td>73</td>
</tr>
<tr>
<td>Palmerston North</td>
<td>133</td>
<td>100</td>
</tr>
<tr>
<td>Hutt</td>
<td>177</td>
<td>133</td>
</tr>
</tbody>
</table>

[33]
The problem is to determine what might make a successful programme. The first criterion seems to be that the aim of the programme should be clear and reasonably specific. This point was made earlier. This should help determine what interventions to use. Another important point to consider is the characteristics of the target population. Not only do the risk factors for different types of LBW (IUGR, prematurity and so on) differ, but also the percentages of these types vary in different populations. It is therefore preferable, if not essential, to develop a risk scoring system specifically for the target population. If an existing system was adopted in New Zealand, however, Creasy's may be the most applicable as it has been tested in an Auckland population. If a high risk target group is being sought this would be Maori, under 20 year old women living in Takapuna, South Auckland, Napier, Wanganui, Nelson or Dunedin health districts.

All this assumes a risk approach is followed. There are also good reasons for considering revisions to standard prenatal care and trying to improve access to existing prenatal care. Lumley (1988a) believed the important factors in France's LBW rate reduction may have been population-wide education and provision of paid maternity leave six weeks before birth. Meis et al. (1987a) stated that current prematurity prevention techniques may be better suited to the type of patients who receive private prenatal care rather than public care patients.

It must, however, be kept in mind that a number of the programmes reviewed failed. There were often no obvious reasons why some worked and some did not.

A number of concluding points can be made about the research studies themselves, some of which have been made earlier:

- few use randomised, controlled trials (Milner et al. (1984) argue for the importance of clinical trials in this area);
- many try to find some appropriate group to compare the treatment group with and some then match pairs on specific characteristics. One caution with this is, in view of the unknown actual causes (in many cases) of LBW, there may be important factors not matched for. They could be the reason for any difference between treatment and comparison groups;
• it is often difficult to compare apparently similar studies as sometimes authors have not described the interventions sufficiently nor presented results clearly;

• with multi-component interventions, it is impossible to tell which interventions work and which do not. Bryce and Stanley have made the point that:

  Just as it is absurd to think of preterm birth as a single cause phenomenon, so it is inappropriate to imagine a single intervention could dramatically alter the rate of preterm births. However, in order to ascertain the most cost-effective interventions and to minimise adverse effects, single component interventions need to be assessed. Then inactive components of complex interventions can be abandoned (1985:38).

• Bragonier et al. (1984:65) have suggested that the LBW rate should always be higher than the preterm rate as preterm birth weights are usually also LBW. However, most studies that report both usually give LBW as lower than preterm, which raises some doubt about definitions used. It may be that they are using LBW as meaning IUGR only.
<table>
<thead>
<tr>
<th>NAME OF RESEARCHER &amp; DATE OF PUBLICATION</th>
<th>PLACE &amp; TIME OF STUDY</th>
<th>COMPOSITION/SELECTION OF STUDY GROUP</th>
<th>COMPONENTS OF THE INTERVENTION</th>
<th>RESULTS</th>
<th>COMMENTS</th>
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</thead>
</table>
| Brooks-Gunn et al. (1988)               | USA, Harlem Hospital, NY | Low SES women                       | • Intensive outreach programme to locate pregnant women not receiving prenatal care
• transportation allowance
• child rearing and health info | • smoking was the major predictor of LBW
• no other results given here | Use of outreach workers was too expensive for the number of women they reached |
| Clark et al. (1986)                     | NZ, Auckland, Middlemore Hospital clinic (Dec 1981- Dec 1983) | Women, 16 or under mostly Maori or P1, unemployed, single (n = 55) | Special antenatal clinic at hospital - regular care, extra education and counselling. Missed appointments followed up. | Significant improvements on a number of pregnancy and infant measures. | Comparison - 55 women of similar age and background at regular clinic |
| Ershoff et al. (1983)                   | USA Southern California Hospital clinic (Dec 1980- March 1981) | HMO enrollees (n = 57) | • Individual nutrition counselling
• smoking cessation course by correspondence | More women in intervention group:
• quit smoking (esp. among light smokers)
• made more changes to their diets
• had lower incidence of LBW, but ns (71% vs 9.7%)
• had significantly higher mean birth weight | Comparison Group not well selected - e.g., one third also had nutrition counselling. |
| Felice et al. (1981)                    | USA University of Maryland Hospital | Adolescents, 15 or under, 93% black (special teen clinic) (n = 67) | • multidisciplinary team, incl. obstetric, nutrition, psycho-social care. Conferences at end of each day discuss every clinic visit.
• at least one home visit by PHN and social worker | LBW rate:
Intervention group = 9%
comparison group = 20.9% | Comparison group matched for age, race, SES and parity; attending the same hospital regular obstetric clinic |
| Herron et al. (1982)                    | USA, San Francisco California hospital (July 1978- June 1979) | Women at Univ. high risk: special weekly clinic - education re preterm labour; pelvic exam
• additional staff training and education | Preterm birth rate
In both high and low risk combined was 2.4%; the year before project began was 6.75% at that hospital | No control group |
| Hobel and Bemis (1986)                  | USA, West area Los Angeles Prematurity Prevention Demonstration Project | Women delivering at UCLA medical centre | Assess risk: Interventions include bed rest, ‘psycho-social support’, an oral progestin and education | Preliminary results:
HR LR % %
Treatment 5.7 5.53
Control 8.54 4.77 (p = 0.05) | Different clinics were randomly assigned to treatment or control |
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<tbody>
<tr>
<td>Korenbrot</td>
<td>USA, California</td>
<td>Low income women</td>
<td>prenatal visits; nutritional and psychological assessment, counselling if necessary; childbirth education and various diagnostic tests</td>
<td>LBW 61% lower for project group than comparison group</td>
<td>Comparison group - women receiving care under Medicaid (not enough info. given to judge comparability.)</td>
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<td>Behrman (1985)</td>
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<td>Koteictiuck et al. (1984)</td>
<td>USA</td>
<td>Massachusetts 1978</td>
<td>Women receiving state-provided nutrition services (n = 4126)</td>
<td>Monthly food vouchers tailored to individual needs. Nutrition education.</td>
<td>Significant improvements in LBW and adequate care received: LBW-WIC 6.9%, Control 8.7% (p&lt;0.01) Control-matched on 5 characteristics with women in State not receiving WIC care</td>
</tr>
<tr>
<td>Larson (1980)</td>
<td>Canada, Montreal</td>
<td>French or English/Canadian; 18-35; working-class income; high school graduation or less; (n = 115)</td>
<td>Three groups: (a) home visits pre- and postnatal, (b) home visits postnatal, (c) no home visits</td>
<td>Assessments made of mother and infant: those who received home visits beginning prenatally 'clearly benefitted'. Those whose home visits began postnatally gained little compared to controls</td>
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<tr>
<td>Main et al. (1985)</td>
<td>USA University of Pennsylvania 1983</td>
<td>Black women (n = 380, including 132 'high risk')</td>
<td>Risk assessment: High risk-weekly pelvic exam; education on preterm labour</td>
<td>Preterm LBW (HR clinic 25% 21.9%, HR control 20.6% (ns) 19.1% (ns) LR 12.9% 14.9%)</td>
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<td>Mels et al. (1987)</td>
<td>USA, northwest North Carolina July 1984-July 86</td>
<td>all patients at all county health dept. clinics and some private doctors. (n = 17370 births)</td>
<td>• patient education re preterm labour • 'intensive prenatal care' for at risk patients, including weekly cervical exams, assessment of uterine activity of patients with signs of preterm labour.</td>
<td>• LBW regional ave. 1980-84 = 7.48% 1986 = 6.7% (approx) • rates for private patients: in project = 5.87% not in project = 7.34 (ss) Approx 42% of all births in the region were in the project.</td>
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<td>Buescher et al. (1989)</td>
<td>USA, Chicago 1983</td>
<td>Women living in a public housing area (n = 41)</td>
<td>Mobile prenatal health education (using a van)</td>
<td>No differences between treatment and comparison group on inpatient hospitalisation or obstetric problems</td>
<td>Comparison - 41 matched women not receiving the mobile care but delivering at the same hospital (NB. all received some prenatal care)</td>
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### APPENDIX

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<tr>
<th>RESEARCHER</th>
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<tr>
<td>Olds (1969, 1972, 1983, 1984, 1986, 1989)</td>
<td>USA, Elmira County, New York State (April 1978 - Sept 1980)</td>
<td>Mainly women &lt;25 weeks pregnant who: &lt;19 years old or single or low SES (n = 400)</td>
<td>- Nurse home visiting (prenatal and till child was 2) - provided education and encouraged support networks - free transport to prenatal visits</td>
<td>Treatment group: children - fewer hospitalisations, fewer cases of abuse/neglect (ns). Mothers - reduced number of cigarettes smoked; improved diet. • LBW rate: treatment = 5.7%; comparison = 2.61% (ns) but 14-16 year olds - treatment = 0% comparison = 11.76% • preterm birth rate lower for smokers • poor, single women had one third less pregnancies in 2 years postpartum</td>
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<td>Papiernik et al. (1985a)</td>
<td>France, A Bièilère Hospital, Clamart, Paris, 1973-</td>
<td>n = 11000+</td>
<td>Risk assessment. Regular cervical exams; patient education for preterm labour; entitlement to paid maternity leave 6 weeks prior to expected date of delivery</td>
<td>Significantly fewer LBW babies to women who sought care early, compared to later. Preterm rate: 1973 - 6.3% 1976 - 3.5%</td>
<td>Positive results depend on early and regular attendance: for early attenders there were no differences by social class</td>
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<td>Papiernik (1984, 1985b)</td>
<td>France, Haguenau (1971-1972)</td>
<td>A city in eastern France; about half were low-income women</td>
<td>Risk assessment. (Interventions have varied at different times): cervical exams; cervical cerclage; reduction in physical activity; entitlement to paid maternity leave 6 weeks pre-delivery</td>
<td>LBW Preterm 1971-74 4.6% 5.4% 1975-78 4.0 4.1 1979-82 3.8 3.7 (ss) (ss)</td>
<td>Reductions did not occur in the most high risk but in lower risk women</td>
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<td>Papiernik (1984) &amp; Goujon et al. (1984)</td>
<td>Island of Martinique, Caribbean 1977</td>
<td>n = 7000+ births</td>
<td>Set up new prenatal 'dispensaries' run by midwives under physician supervision. - patient education; reduction in physical activity, some home visits etc</td>
<td>The project women were compared to women receiving private care - the project women were lower SES, while there were no ss differences in LBW or preterm rate.</td>
<td>Midwives referred high risk women to specialists or hospital (c30%).</td>
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<td>Peoples &amp; Siegel (1985)</td>
<td>USA, North Carolina maternity and infant care project (1970-1977)</td>
<td>'disadvantaged' women (n = 5822)</td>
<td>• public health nursing, nutrition and social services, health education dental and medical care, transportation, outreach activities.</td>
<td>Improved use of prenatal care but no overall impact on LBW. Project group = 11.5% Comparison = 9.9% Non-white teenagers: Project - 12.6% Comparison = 14.4%</td>
<td>Project involved 29.4% of all deliveries in the region. Comparison group were in nearby counties similar in SES, health resources &amp; perinatal status. However, MIC women had higher risk status than comparison.</td>
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<tr>
<td>Peoples et al.</td>
<td>USA, North Carolina</td>
<td>Low income, black women</td>
<td>Nurse midwives, outreach activities, transportation, high-risk clinic, nutrition counselling, social services, health education.</td>
<td>Improved use of prenatal care but no impact on LBW: Project = 11.6% Comparison = 10.1 (ns)</td>
<td>Project involved 52% of all black deliveries in the region. Comparison group were women from nearby non-project counties. IPO women had more risk characteristics.</td>
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<td>(1984)</td>
<td>Improved Pregnancy</td>
<td>(n = 648)</td>
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<td>Outcome Project (1979-1981)</td>
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<td>Piechnik &amp;</td>
<td>USA, medical university of South Carolina</td>
<td>adolescents, &lt;18 years old</td>
<td>• multidisciplinary team, incl: nutrition counselling, social work, nine weekly prenatal classes.</td>
<td>LBW rate: intervention = 9.2% comparison = 12.7% (ns, p&lt;0.15)</td>
<td>Comparison group was &lt;18 year olds in rest of state receiving state-funded prenatal care, 1976-78.</td>
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<tr>
<td>Corbett (1985)</td>
<td>South Carolina 1974-1978</td>
<td>83% non-white but not those with any serious medical/obstetric problems</td>
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<td>(n = 490, 1976-1978)</td>
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<td>Sokol et al. (1960)</td>
<td>USA, Cleveland Metropolitan General Hospital</td>
<td>Patients at hospital or one of 5 satellite clinics, who reside in designated underprivileged areas (n = 3307)</td>
<td>• health education, • nutrition counselling, • parenting guidance, • home visits if necessary, • free dental services, • routine prenatal care</td>
<td>• Preterm delivery (&lt;37 weeks) treatment = 17.9% comparison = 22.7% (ss) • children weighed significantly more: treatment LBW = 11.7% comparison = 14% (ss) • treatment group had approx half the stillbirth rate and third neonatal death rate</td>
<td>comparison group used same clinics: but not in project because they live outside target areas. Similar on a number of socioeconomic factors.</td>
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</tbody>
</table>
References

Avison WR et al. (1986) SCREENING FOR PROBLEM PARENTING: PRELIMINARY EVIDENCE ON A PROMISING INSTRUMENT, Child Abuse and Neglect 10:157-70

Backett EM et al. (1984) THE RISK APPROACH IN HEALTH CARE WITH SPECIAL REFERENCE TO MATERNAL AND CHILD HEALTH, INCLUDING FAMILY PLANNING, Public Health Papers 76, Geneva: World Health Organisation


Bryce RL (1989) Personal communication with author, 26 July 1989: Department of Health file 345/5/8/1


Chapalain MT (1978) PERINATALITY: FRENCH COST-BENEFIT STUDIES AND DECISIONS ON HANDICAP AND PREVENTION, in Major Mental Handicap Methods and Costs of Prevention, Ciba Foundation symposium, ns59, Amsterdam and New York: Elsevier/Excerpta Medica/North Holland, 193-204


Clarkson JE et al. (1988) PREDICTING AND PREVENTING PARENTING PROBLEMS, NZ Medical Journal 101:12-14

Creasy RK et al. (1980) SYSTEM FOR PREDICTING SPONTANEOUS PRETERM BIRTH, Obstetrics and Gynecology 55:692-95
Ernest JM et al. (1988) IDENTIFICATION OF WOMEN AT HIGH RISK FOR PRETERM - LOW BIRTHWEIGHT BIRTHS, Preventive Medicine 17:60-72
Ershoff DH et al. (1983) BEHAVIOURAL, HEALTH AND COST OUTCOMES OF AN HMO-BASED PRENATAL HEALTH EDUCATION PROGRAM, Public Health Reports 98:536-47
Kramer MS (1987a) INTRAUTERINE GROWTH AND GESTATIONAL DURATION DETERMINANTS, Pediatrics 80:502-11
REFERENCES


Monaghan SM et al. (1986) PRENATAL SCREENING FOR RISK OF MAJOR PARENTING PROBLEMS: FURTHER RESULTS FROM THE QUEEN MARY MATERNITY HOSPITAL CHILD CARE UNIT, *Child Abuse and Neglect* 10:369-75


Olds DL (1984) CASE STUDIES OF FACTORS INTERFERING WITH NURSE HOME VISITORS' PROMOTION OF POSITIVE CARE-GIVING METHODS IN HIGH RISK FAMILIES, Early Child Development and Care 16:149-165


Olds DL et al. (1986a) IMPROVING THE DELIVERY OF PRENATAL CARE AND OUTCOMES OF PREGNANCY: A RANDOMIZED TRIAL OF NURSE HOME VISITATION, Pediatrics 77:16-27

Olds DL et al. (1986b) PREVENTING CHILD ABUSE AND NEGLECT: A RANDOMIZED TRIAL OF NURSE HOME VISITATION, Pediatrics 78:65-78


Papiernik E et al. (1985b) PREVENTION OF PRETERM BIRTHS: A PERINATAL STUDY IN HAGUENAU, FRANCE, Pediatrics 76:154-158

Peoples MD and Siegel E (1983) MEASURING THE IMPACT OF PROGRAMS FOR MOTHERS AND INFANTS ON PRENATAL CARE AND LOW BIRTH WEIGHT: THE VALUE OF REFINED ANALYSES, Medical Care 21:586-604


Ross MG et al. (1986) A SIMPLIFIED RISK-SCORING SYSTEM FOR PREMATURITY, American Journal of Perinatology 3:339-44

REFERENCES


Zuckerman B et al. (1983) NEONATAL OUTCOME: IS ADOLESCENT PREGNANCY A RISK FACTOR?, Pediatrics 71:489-93