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# Low Birth Weight Review of risk factors and interventions

## Summary Report

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**Purpose and Summary of Document:**

This document summarises a technical review of the evidence available for estimating the population attributable risks for low birth weight and preterm birth which are due to risk factors which can be modified at a population level.

# 1 Background and Introduction

In Wales in 2011 over 2400 live births were recorded as low birth weight (LBW) babies (born weighing less than 2500g) (6.8% of all live births) with this proportion varying across Wales from 6.2% in Cardiff and Vale local health board (LHB) to 8.2% in Cwm Taf LHB area(1) . LBW is important as birth weight is inversely associated with infant mortality, life expectancy, and is predictive of disability and educational achievement as well as diabetes, stroke and heart disease in adults. Consequently it is considered a key predictor of health inequalities. There is currently significant interest in reducing the number of LBW babies born in Wales every year.

It is important to recognise that babies who have a LBW can be further categorised as those that are small because of their premature gestational age at birth but have birth weight that is appropriate for their gestational age, and those who are small despite their gestational age (small for gestational age).

Whilst there are a number of risk factors understood to cause LBW(2), much emphasis has focused on smoking in pregnancy as a significant modifiable risk factor in LBW. The proportion of LBW births that could be avoided if maternal smoking is eliminated, has been estimated as ranging from 10-27% (3). However, from this it can be surmised that 73-90% of low birth weight births can be attributed to other factors.

The proportion of low birth weights that can be avoided from elimination of a risk factor, called the population attributable risk, is controlled by the increased risk associated with that risk factor, and the number of people in the population effected. Consequently, factors can have a large impact because they present a small risk to many people, or because they present a very large risk to a smaller group of individuals. This report will examine the evidence factors which increase the risk, and exposure to those factors in Wales in order to estimate the impact of each risk factor on the number of low birth weight babies born in Wales.

The technical details of this investigation, justification for findings, and review of the evidence for individual risk factors is presented in detail in the companion technical report(4). This summary report outlines the broad findings of the review.

## 2 Aims and Objectives

The aim of the project was to inform what interventions could be applied at the population level to reduce the incidence of low birth weight births in the Welsh population, and to understand the potential impact these interventions can have on low birth weight.

In order to fulfil this aim a set of objectives were prepared setting out the main research questions relating to identifying risk factors, determining their contribution to low birth weight and examining the evidence for interventions to reduce the risk.

### **3 Method**

An initial scoping search of the literature identified a review of the determinants and interventions for the prevention of Low Birth Weight carried out by the Institute of Health Economics (IHE) in Alberta Canada and published in 2008. This report carried out a pragmatic review of studies with outcomes of low birth weight, prematurity and small for gestational age, and used this to determine which factors had associations with the outcomes and the strengths of those associations. It also examined evidence for interventions for these risk factors and their success in improving the outcomes of interest. The IHE report has formed a baseline to this project and the parameters used in the detailed literature search. This report has formed a baseline to the work.

#### **3.1 Limits of literature search**

The current review identified areas where action can be taken at a population level to reduce the prevalence of low birth weight. Consequently it has got to be acknowledged that some factors (e.g. older maternal age) although technically modifiable through health education are not ethically acceptable and therefore can be excluded. Consequently, the modifiability of risk factors at a population level is subjective as it contains a judgement about the acceptability of modification.

Comparison of studies was not always straight forward due to a large number of different terms and techniques used by studies in this area. There were several different outcomes which were dependent on local classifications (e.g. small for gestational age) and where therefore not necessarily comparable. Birth weight studies also often use mean reduction in birth weight as an outcome, which was not suitable for population attributable risk calculations. Some subdivisions were also reported (e.g. very low birth weight (<1500g)). For consistency this review examined low birth weight (<2500g) and preterm birth (<37 weeks) outcomes only.

Searches performed for review articles, and individual studies published in English returned nearly 3000 potential papers. These were screened by title and then by abstract using a strict set of criteria. Papers included must:

- describe a risk factor for low birth weight that is considered modifiable;
- produce a relative risk or odds ratio for the association;
- not describe a condition for which low birth weight was a risk factor;
- not describe clinical management of LBW or premature infants.

A total of 111 papers were identified which met the search criteria.

## 4 Findings

### 4.1 Principle risk factors

The principal risk factors identified range in the magnitude of the contribution that each offers to the overall burden of Low Birth Weight in the population. The relative importance of each risk factor has been summarised for both low birth weight (Table 1).

The largest modifiable risk factor for low birth weight in Wales is exposure to tobacco smoke, which has been estimated as being responsible for more than twice the number of low birth weight babies than the next largest factor anaemia. Exposure to tobacco smoke includes both maternal smoking and exposure to environmental tobacco smoke in the home (Fig. 1).

Exposure to environmental tobacco smoke in pregnancy has been demonstrated to be an important barrier to reducing the impact from maternal smoking cessation on low birth weight. Within the majority of smoking households somebody other than the mother smoked. It is estimated that even if maternal smoking was entirely prevented a third of mothers would remain exposed to tobacco smoke during pregnancy. Coupled with the fact that smoking cessation interventions are longer lasting and have higher success if family members do not smoke it is clear that behaviour of others within the household must be targeted to have a meaningful impact.

Other risk factors with substantial contributions are related to diet, substance misuse and sexual health. Anaemia has been identified as large contributor to low birth weight. Although the contribution of vitamin D deficiency to low birth weight has not been estimable, evidence suggests it may be the largest contributor to preterm birth, and therefore will contribute to a substantial proportion of low birth weight. Low BMI is also identified as a risk factor. Much public health emphasis is placed on healthy weight in pregnancy, however, this is mostly articulated as not overweight or obese.

For substance misuse, the largest risk is associated with using heroin, methadone and cocaine, whilst using alcohol and cannabis present smaller risks. However, the use of cannabis is more widespread, which increases the contribution of this risk factor to the population burden of low birth weight.

Infections are also a major contributor to low birth weight at a population level. Sexually transmitted infections (e.g. Chlamydia), vaginal infections (e.g. Bacterial Vaginosis) and other infections (e.g. Periodontitis) have been shown to increase the risk to varying degrees. Importantly, some of these illnesses can be asymptomatic and therefore the individual may not be aware or seek available treatments. For periodontitis, there is no evidence that treatment during pregnancy improves outcomes, and therefore any intervention to reduce this needs to be about general oral health in women of child bearing age.

**Table 1: Risk factors for low birth weight ranked according to their estimated population attributable risk**

Risk Factor	Relative Risk/ Odds Ratio	Exposure Prevalence %	PAR %
Tobacco Smoke	1.9 / 1.32 (ETS)	16 / 20-29 (ETS)	18-21
Anaemia	1.39	24	8.6
Heroin / Methadone	3.28-4.61	2	4.4-6.7
Bacterial Vaginosis	1.43	10-15	4-6
Periodontitis	1.5-1.8	7.2	3.4-5.4
Cannabis	1.09-1.7	8.5-15	0.8-9.5
Short Birth Intervals	1.06-1.6	17	2.9
Cocaine	2.85	1.1	1.8
Low BMI	1.64	2.9	1.8
Chlamydia	1.52	1.65-5	0.9-2.5
Teenage Pregnancy	1.17-1.19	3.7	1.2
Alcohol	1.57	2	1.1
Vitamin D	Not quantified		
Air Pollution			
Folic Acid			
Stress			
Unintended Pregnancy			
Intimate Partner Violence			
High BMI			
Occupational Factors			
<b>Key</b>			
Rank	RR/OR	Prevalence	PAR %
Very High	>2	>10%	>10%
High	1.5-2	5-10%	5-10%
Moderate	1.25-1.5	2.5-5%	2.5-5%
Low	1.0-1.25	<2.5%	<2.5%

Risk factors such as exposure to tobacco smoke at home, diet, substance use and sexual health are usually linked to behaviour in the family and household. To make substantial changes in the risk of low birth weight, interventions involving whole families should be considered.

From this it is clearly demonstrated that a group of key modifiable risk factors provide the bulk of the overall prevalence of the two outcomes. These risk factors can be grouped into specific areas including tobacco smoke exposure, sexual health (including infections and contraception), nutrition and substance misuse.

Focus on action in the areas of tobacco smoke exposure, sexual health (including infections and contraception), nutrition and substance misuse should deliver important improvements in the risk of adverse pregnancy outcomes. It is not possible to estimate the total population attributable risk from modifiable risk factors because the casual pathways for each overlap substantially and there is evidence of confounding in the interrelation between the risk factors. However, it is clear that through modifying these behaviours it should be possible to substantially reduce the prevalence of low birth weight in Wales.

Outside these main risk factors are another group of factors where policy or action is needed throughout life, rather than just in pregnancy to reduce the risks. These include addressing air pollution and encouraging adequate dental health. These risk factors cannot be addressed for pregnant women alone and require wider solutions. However, inequalities in exposure have been shown to contribute to inequalities in low birth weight and prematurity.

## 4.2 Clustering of risk factors

It is clear from the evidence identified on the prevalence of the key risk factors that for most factors the group with the highest exposure and consequently the highest risk of having a low birth weight or premature baby are the same (Figure 1). For many of the risk factors the highest prevalence is seen in mothers who are under 25 in lower income households and in areas of deprivation.

It can also be shown that in several cases the risk factors are not independent, and that exposure to tobacco smoke in particular increases the likelihood of exposure to others (e.g. bacterial vaginosis). Exposure to several risk factors presents larger cumulative risks.

It is clear from prevalence data that there are significant inequalities in the low birth rate, and these are likely to be attributable to inequalities in exposure to the key risk factors. It is important to ensure that in reducing low birth weight, inequality in low birth weight is also reduced. Therefore, in addition to universal intervention in pregnancy it is vital that intensive intervention and support is provided to those at the highest risk, and all partners working with the high risk groups should consider how they will

contribute to reducing exposure to all risk factors and supporting high risk mothers as part of their work to reduce low birth weight.

It is also clear that improving constellations of risk factors has a greater potential to reduce low birth weight and prematurity. Exposure to risk factors may also be dependent on the actions of those around the mother, which requires an approach where context is considered important. Taking the example of maternal smoking, the current emphasis is on individual interventions to prevent maternal smoking. However, the evidence presented is clear that the burden from environmental tobacco smoke is also substantial for women who do not smoke. Women in smoking households are also less likely to give up on pregnancy, and even if they do they are more likely to resume smoking afterwards. Therefore it is important that smoking is also tackled at household or family level to ensure that the total benefits are achieved.

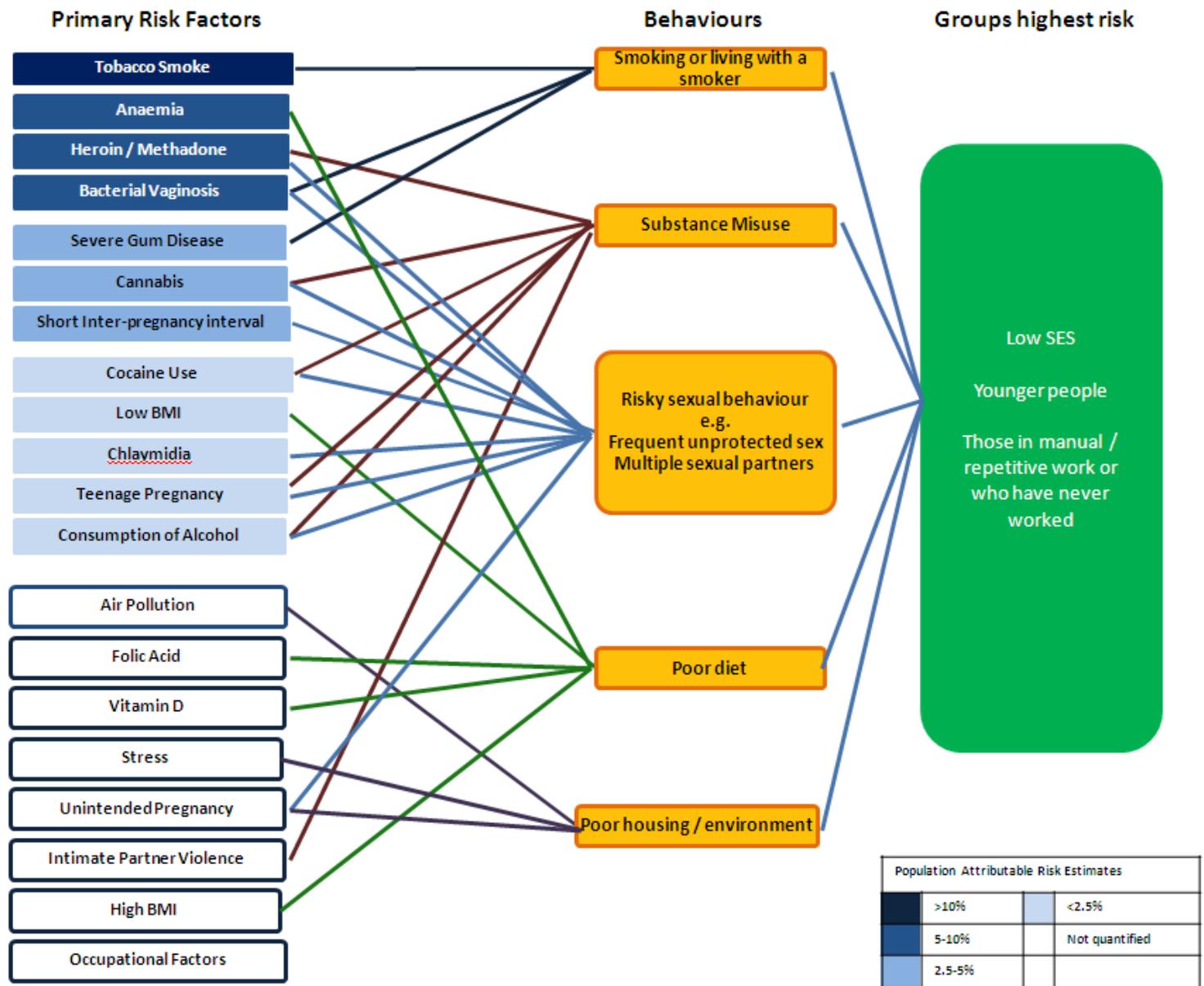
It is therefore important to consider that to achieve a large scale change in low birth weight we must stop viewing these risk factors in isolation from each other, and the mother in isolation from her surroundings. Better results should be achieved by providing integrated interventions that act on a wide range of known risk factors simultaneously. These multi-faceted interventions should be targeted at all levels, individuals, communities and families where a number of risk factors are known to coincide. Furthermore, identification of those who should receive interventions or support and signposting and access to these services for all should be enabled and supported by all stakeholders delivering services in these communities.

### **4.3 Interventions / approaches known to work**

It is clear from the data presented that the main risk factors cluster more often in areas of deprivation and in areas where people are becoming pregnant at younger ages. Also that risk factors cluster together. In order to reduce the inequalities in low birth weight it is important that interventions are targeted at high risk groups and clusters of risk factors. There have been a number of interventions that have been shown to have impacts in this way from which lessons can be learned.

#### **Timing of intervention**

Within the range of risk factors identified it is apparent that intervention is required at different times (e.g. smoking cessation during pregnancy reduces risk for that pregnancy whereas risk from short inter-pregnancy intervals can only be reduced by intervention pre-conception). Differences in effectiveness based on timing of interventions has been summarised (Table 2).



**Figure 1: Driver diagram linking primary risk factors identified to related lifestyle factors and high risk groups**

**Table 2: Timing for intervention with key risk factors**

Risk Factor	Preconception†	In Pregnancy	
		Early	Late
Tobacco Smoke	✓	✓	
Bacterial Vaginosis		✓	
Young Maternal Age	✓	These factors can only be impacted preconception	
Birth Interval	✓		
Periodontal Infections	✓		
Sexually Transmitted Infections	✓	✓	
Substance Misuse	Little evidence on intervention available		
Low / High BMI	✓		
Nutrient Deficiency	✓		✓
† Preconception intervention includes postnatal interventions within an inter-pregnancy period			

### Integrated Interventions

There is evidence that risks can be reduced substantially by using integrated approaches to risk factor management. Integrated care has been demonstrated through evaluation of services such as Prenatal+ delivered in Colorado USA. This intervention provided women identified as high risk with a care co-ordinator who supported access to a team who assisted the women to develop and maintain healthy lifestyles providing nutritional and psychosocial support aimed at improving reducing smoking and substance use. Reported results indicate that nearly 40% of women resolved their risk factors and that the risk of a low birth weight outcomes was lower in those that changed behaviour. Better outcomes were observed for women who resolved several risk factors they were exposed to(5).

### Family Nurse Partnerships

One program that has been extensively researched is the Family Nurse Partnerships approach which has also been piloted and evaluated in England and Scotland. This program is a voluntary home visiting programme for first time mothers aged 19 or under from pregnancy until the baby is 2. Therefore, this programme is currently able to influence low birth weight through improving prenatal health. There is also evidence from the evaluation of the pilot programme that those involved displayed the clustering of risk factors highlighted by this report. The programme has demonstrated its ability to have an impact on maternal nutrition, smoking and substance misuse (6,7,8).

This is a evidence based intervention which delivers in the risk areas highlighted and with the groups of interest. The potential impacts of FNP if applied to the Welsh population should be considered to determine the likely impact on low birth weight. Furthermore, lessons from implementation in England and Scotland should be considered when available, in relation to potential benefits of delivering programme in Wales.

## 4.4 Key Findings

The key findings of this report are summarised as

- A small number of risk factors including exposure to tobacco, poor sexual health, poor nutrition and substance abuse contribute substantially to the burden of low birth weight an inequalities.
- These risk factors have been shown to group together in younger women with lower socioeconomic status
- Risk reduction is more effective if applied to multiple risk factors by using a multiagency approach
- Integrated approaches, using intensive home visiting, such as FNP have been shown to deliver improvements for many of these risk factors to those at most risk(6).

## 5 Recommendations

Following this detailed review of the evidence into the modifiable risk factors that can make a difference at population level to low birth weight in Wales this report make the following recommendations.

### 1. Specific Risk Factors

- a. *Tobacco exposure in pregnancy needs to look at both active smoking and exposure to second hand smoke.* Repeated exposure to tobacco smoke, most likely in the home, is the largest modifiable cause of low birth weight. It remains important to ensure pregnant women do not smoke. However, the risk is only partially reduced unless pregnant women live in smoke free households. Smoking cessation is more durable and more effective if other members of the household do not smoke. Substantial reduction in risk requires intensive support for all household members who smoke to quit during pregnancy.
- b. *More emphasis is needed on low BMI and nutrient deficiency.* Evidence suggests that inadequate nutrition contributes substantially to the burden of low birth weight. This is due to nutrient deficiency (Iron & Vitamin D) and low BMI. Emphasis on healthy weight is currently directed at obesity, however, large numbers of women in deprived areas are underweight. .

- c. *Consider sexual health as a marker around which many risk factors cluster.* Risk factors mitigated by appropriate sexual health support have been identified including effective contraception (short birth intervals, substance misuse, unintended pregnancy, teenage pregnancy), sexually transmitted disease prevention (Chlamydia, Bacterial Vaginosis). Intervention in these areas before and during pregnancy can help reduce the risk of low birth weight in current and future pregnancies.

## **2. Intervention Approaches**

- a. *Deliver multi-faceted interventions for clusters of risk factors –* More effective reductions in low birth weight, and more effective deployment of resources should be possible by using interventions that address packages of risk factors, not individual ones. For example, it is not sufficient to signpost the mother to a smoking cessation intervention. The intervention should also support improvements in nutrition and sexual health for her and her family.
- b. *In communities with highest prevalence of main risk factors, all partners should take a role in identifying, signposting and delivering interventions to those identified as at risk.* All services working with individuals and families at higher risk of exposure to multiple risk factors should consider how they will support interventions to reduce exposure and low birth weight. There are often many organisations working with families at highest risk (e.g. Flying Start, Families First, Communities First, Local Authority Social Services, Food Banks, NHS). All organisations need to systematically work together and determine how they can support improved nutrition, sexual health, substance use and exposure to tobacco through co-ordinated multidisciplinary action.
- c. *Due to strength of evidence, consider evaluation of delivery of Family Nurse Partnership in other parts of UK to assess impact of implementing this programme in Wales*

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