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## An investigation into child health indicators in North Wales

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### A STUDY OF LOW BIRTH WEIGHT BABIES BORN IN DENBIGHSHIRE BY POST CODE, AND CORRELATIONS WITH MEASURES OF DEPRIVATION

#### Study background

The study described in this paper was conducted as a result of repeated concerns expressed in Welsh public health reports, regarding the high incidence of low birth weight births in Wales. The annual report of the Chief Medical Officer (Welsh Office 1997) found that risk of infant death, as with death at around time of birth, is greatly increased by low birth weight,

*“This is of great concern, given the association of low birth weight, not only with infant and peri-natal mortality, but also with some major causes of ill health and death later in life.”*

*Chief Medical Officers Report p 29 (Welsh Office 1997)*

Recent statistics indicate a deteriorating health trend, with percentage of low birth weight babies being 7.2% in 1995 (Welsh Office 1995) and 7.4% (Welsh Office 1998.) Low birth weight is also considered a priority in the consultation document *Children and Young People* and as a key area for work in the Sure Start programme. (The National Assembly for Wales, 2000). This evidence identifies need for further study to examine the incidence of low birth weight in detail. It is also considered useful to note any association with deprived areas.

The Chief Medical Officers’ Report (Welsh Assembly, 1998), rank Denbighshire eighth highest for low birth weight births of twenty-two local authority areas studied in Wales. Statistics published by the National Assembly for Wales, give an average figure for each local authority area studied, these statistics tend to suffer from area dilution, and have the effect of concealing problem areas.

Further work, by many researchers, for example, Barker et al (1989), McCrabb et al, (1991), Barker et al (1993), (1995), and Barker (1999) note associations between maternal under nutrition, low birth weight, and with adult morbidity, for example, diabetes, hypertension, and cardiovascular disease. Margetts et al (1991), Whincup et al (1994), Leon et al (1996), Stein et al (1996), Frankel et al (1996), Dalquist et al (1996), Stanner et al (1997), Leon et al (1998), Forsen et al (1999), Smith et al (2000), have also conducted similar studies. Studies by Pharoah et al (1994), Klebanov et al (1994), Breslau et al (1996), Schothorst & England (1996), Olsen et al (1998), Horwood et al (1998), Resnick et al (1998), Resnick et al (1999), Ment et al (1999), report relationships between low birth weight, prematurity, and associations with childhood morbidity, for example Attention Deficit Hyperactivity Disorder, behaviour problems and multiple neurological disorders.

The association between low birth weight and other causative factors has been the subject of multi-national research for many years. Many authors, for example, Taylor et al (1987), McDonald & Maynar (1985), Royal College of Physicians (1987), Townsend et al (1994), Czeizel et al (1994), Peacock et al (1995), Conter et al (1995), Chomitz et al (1995), and Blair et al (1996), Canadian Institute of Health (1996), Hoo et al (1998), Alm et al (1998), and Cook et al (1999), report associations between low birth weight and multiple factors. These factors include alcohol abuse, drug abuse, smoking, socio-economic factors, psychological stress,

and their association with multiple adverse outcomes, for example, low birth weight, sudden infant death syndrome, foetal alcohol syndrome and congenital limb deformity. The effect of poverty on the nutrition of deprived populations has been widely researched. Gregg et al (1999), Joseph Rowntree Foundation, and the Child Poverty Action Group (2000), report an association between poor nutrition and low birth weight. The Child Poverty Action Group found that, “mean birth weight is lower for babies whose fathers are in manual social classes, and even lower for babies who birth is registered only by the mother”.

Platt (1998), Lynch et al (2000), Smith et al (1998) Smeeth & Heath (1999), and Spencer (1999) suggest strategies for tackling severe inequalities in health, detailed in recent reports and statistical information.

### Ethical approval

Discussion took place with the Chairperson of the ethics committee North Wales Research Committee, because only anonymous secondary data was to be used, approval was given for the project to progress without further consideration.

### Secondary data and Census data.

Flowerdew and Martin (1998) comment on use of secondary data recommending that it may be analysed and re-analysed, to demonstrate actual, or potential relationships between variables.

Majeed et al (1995) report difficulties regarding accuracy of some census data because this is altered to maintain confidentiality, and note particular problems when using census data of small areas. Dale and Marsh (1993) also found problems in the use of census data including under numeration of the population, which was calculated as being approximately 2%. Dale and Marsh advise caution, in the use of Small Area Statistics, describing changes in results, which can occur because of modification to data, to protect confidentiality. Problems also occur because of under numeration. Majeed et al found that under numeration at the time of 1991 census was approximately 2.2%, and further, that under numeration was highest in inner city areas, among men aged 20-29 years. Approximately 9% of men in this age group nationally, and nearly 20% in inner London were not enumerated. Newell (1998) also describes myriad errors and biases in census data collection, advising simplicity of method.

### Methods of data analysis

Fotheringham (1998) recommends the display of data, or results on a map, which uses characteristics of spatial data, giving data spatial locations. Fotheringham also advises use of *strong geographical techniques*, where the purpose is to discover whether or not, points in space are clustered. This is viewed as being of particular importance when studying medical data, where disease may have a point source. The low birth weight data was analysed by postcode area, and County Council/Borough areas, and not enumeration districts, because of difficulties of analysing small census data, already described. Robinson (1998) advises further analysis because of the areal unit problem, recommending use of correlation coefficients, identifying *Pearsons' Product Moment Correlation Coefficient* as a suitable statistical test, to test strength of relationships between types of variables studied.

## Methodology

### Preparation and use of data

Low birth weight data, defined as all babies born between 1/4/95 and 31/8/98 was collected on three separate occasions, working with an identified Systems Analyst, at Welsh Health Common Services Authority (Health Solutions, Wales), to assist in continuity of communication and obtaining relevant data. Issues of ensuring reliability, and internal validity were discussed. It was agreed that more than one pilot data run would be required to confirm internal consistency of data. Reliability of the data provided was discussed, data is provided direct from details of births from Maternity Units across Wales and is similar to that provided to the Registrars' office.

### Population sample

The population sample included all children born within Denbighshire, within the specified dates. On the last data collection dates of birth and length were also requested. The 'date of birth' was required to enable controlling of identified variables, for example, twin or multiple births. The 'length' was also requested to give additional information, and enable comparison of length and birthweight. The programme, ICL

Querymaster-plus Version 255.00, with additional control and handling by Query Master-Plus, (WHCSA Cardiff) returned dates of birth, but length was not available from the system.

### Cleaning and coding of data

Close attention was paid to cleaning and coding of data, and rigorous attention was paid to extraction of data from data sheets supplied. This was counted, firstly by mental calculation, and using a psion calculator, and repeated, to further check for error. Low birth weight data was grouped, by identification of post- code area.

### Analysis of low birth weight data

Low birth weight was identified by sum total of population sample of babies in each post-code area. The total number of births  $n=2778$  was analysed by extracting sum total of babies, 2,500kg and below, and calculating percentages of low birth weight for each post- code area from these figures. This was done by mental calculation, and checked using a psion calculator, and the process repeated. Calculations for each element were finally checked, before inclusion to the database.

### Census data analysis

Both the Jarman Indices and the Townsend Score have different methods of analysis. For the purpose of this study, regression analysis of low birth weight data and census data was assisted by using the same method of analysis for both indicators. The total percentage of each criterion of the relevant census data was calculated by adding per deprivation indicator. This also enabled an easy comparison to be made between the results of each deprivation indicator used.

### Measures of deprivation: use of Census data

Deprivation measures were calculated by analysis of data in documents “A Social Atlas of Clwyd”, and “Key Statistics”, which provided selections of key variables from the 1991 Census by Community Council areas. These were provided by courtesy of the Department of Architecture, Planning and Estates, Clwyd County Council. Data was extracted for all thirty- eight County Council areas within Denbighshire, using appropriate criteria for each deprivation indicator.

For example the Townsend Score employs four criteria,

- Unemployed Males
- Overcrowded households
- Households with no car
- Rented accommodation\*

*\*Rented accommodation was calculated by summing data, for both private and public sector rented accommodation.*

All data was checked for error, by use of random checking, of 1 in 4 items of data extracted. Variables extracted from census data are presented as a percentage of total population. Total variables employed for each deprivation indicator were summed, to provide a percentage of deprivation for each area. This was done by mental calculation, and checked for error by computing.

### 1) Mapping low birth weight and post code boundaries

The distribution of low birth weight (2,500kg and below) was mapped by Post Code boundaries. The low birthweight data (2,500kg and below) was supplied by the Child Health System, Welsh Health Common Services Authority, Cardiff, renamed, *Health Solutions*, Wales. This database was introduced in 1977 to manage the pre school child health surveillance system, and has been shown to be capable of producing a reliable maternal and peri natal data set for Wales (Welsh Health Common Services Authority 1996). The total population sample of babies in the Denbighshire study, were born between 01/04/95 and 31.08.98  $n=2,778$  of births with identifiable postcodes available, were studied by weight and post- code. The trend of low birth weight is compared to indicators of deprivations, using the Jarman Indices and Townsend Score.

## 2) Mapping the Townsend score

The indicators of deprivation recommended by Townsend (1987) were mapped across all thirty-eight County Council/County Borough areas using the Townsend criteria of,

- Unemployed males
- Overcrowded households
- House holds with no car.
- Rented accommodation.

Bodelwyddan, St. Asaph, Denbigh, Bettwys Gwerfill Coch, Cwynwyd, Corwen, Llangollen and Llangollen rural, with deprivation scores between 63.54% and 71.56%. The highest score using the Townsend score was Rhyl with 89.36%

Low birth weight data was compared with the census data using the Townsend Score. Robinson (1998) recommends the use of a parametric test for the purpose of analysing this type of data. Regression analysis was achieved, by use of *Pearson product-moment correlation coefficient* ( $r_{xy}$ ), with its values lying in the range, from, +1.0 to -1.0. A value of +1.0 represents a perfect, positive relationship between two variables.

A value of  $r_{xy} = 0.0$ , indicates the absence of any statistical relationship between  $x$  and  $y$ . This test was applied to data, Low Birth Weight ( $= y$ ) (= predicted  $y$ ) and Townsend Score ( $= x$ ). This was computed as  $r = 0.3542$  with a  $p <$  of  $0.02493$ , showing a mildly positive correlation between low birth weight and the Townsend Score.

## 3) Mapping the Jarman indicators of deprivation

The Jarman Indices (Jarman 1984) were applied to all thirty-eight County Council/County Borough areas, using 1991 Census data. One indicator of elderly population was omitted because of the subject matter of this study. Results show Bodelwyddan, Denbigh, Llanellidan, Cwynwyd, Corwen, Llandrillo, Llantysilio, Llangollen and Llangollen Rural, with deprivation scores between, 72.43% and 91.31%. The highest scores, being Cefnmeiriadiorg (93.5%), Prestatyn (100.02%), and Rhyl (126.16%) Statistical analysis was performed using the *Pearson product moment, correlation co-efficient*. Low birth weight ( $= y$ ) (=predicted  $y$ ) and the Jarman Index ( $= x$ ) was computed as  $r = 0.2052$  with a  $p >$  of  $0.2038$  showed a strong simple correlation between low birth weight and the Jarman Indices.

## Discussion

There is evidence for concern, regarding percentage of low birth weight babies born in some areas of Denbighshire. The justification for further study appears clear. There are statistics available on a national basis, but a lack of studies, focusing on identification of problem areas throughout Wales, by comparing health data with census data.

The analysis of the data found Rhyl area to have the highest incidence of low birth weight births in Denbighshire, at 10%, further analysis revealed an incidence of 7.8% after controlling for multiple births. The process of dilution, which occurs, by the use of overall statistics of Local Authority areas is clearly demonstrated. For example, in Llanarmon-yn-Ial, incidence of low birth weight was 0%, and in Rhyl 10%, (7.8% after controlling for multiple births) a potential mean average therefore, of the two areas combined, using Local Authority statistics method, would be 5% and (3.95%) respectively. This information is particularly significant, in enabling the appropriate targeting of resources.

## Limitations of the study

### Low birth weight data

There were some difficulties with the low birth weight data used. Firstly, there is a significant amount missing from the total data set (approximately 16%), because of a lack of information concerning postcodes. These included a significant number of low birth weight babies and a comparable amount of babies of average weight. These were excluded from the final data set. This decision was taken after two

possibilities were considered, firstly, to completely omit this data, as it contains both low birth weight data and data of babies of average weight. Secondly, to obtain data showing 3<sup>rd</sup> line of address, which it was hoped would place the majority of missing data by 'town' therefore omitting only a few. Ultimately the final data run of 3<sup>rd</sup> line of address could not be used, as it identified a variety of different address information. It is a matter of some concern, that omitted post-codes of babies, may be significantly, families living in flatlet, bed and breakfast, or temporary accommodation.

### Census data

It was formerly intended to use an enumeration district level of analysis of census data, however considerable, literary evidence, warns against data analysis at this level over a large area, because of attenuation of figures at enumeration district level, in order to protect confidentiality. These, if compared with data over a large area, have the effect of producing a skewed result. It was necessary to analyse census data specifically for this study, because of recent county boundary changes. There were no existing geographical data sets designed for the purpose of examining deprivation within Denbighshire. This was achieved by use of revised census data tables published by Clwyd County Council, following establishment of new county boundaries in November 1995. The new county boundaries of Denbighshire had only been recently defined at the commencement of this study therefore maps originally used in the study were hand drawn as maps of Denbighshire at the commencement of the study were extremely scarce.

### Low birth weight and deprivation measures

Mapping the data for low birth weight and deprivation indicators did not encounter any real problems. The analysis of low birth weight data, and census data, when using statistical analysis ie-: *Pearsons' product moment correlation coefficient* was impeded by the difference in area, between post-code area statistics, and census area statistics. This was overcome by aggregation of percentages of post-code, for each County Borough/County Council area, where post-codes did not match the county borough area studied. In order to study low birth weight data in all individual county borough areas, it would be necessary to have complete addresses, which for reasons of confidentiality, is not possible. This has not been thought to skew results of analysis, since the whole result of comparing low birth weight in Denbighshire with 84% of the total number of births by post-code area with measures of deprivation appears achieved.

### Conclusions

The employment of *spatial mapping* enables a pictorial analysis of where high incidences of low birth weight and deprivation exist, as can be viewed in the project showcase. The use of omitted data, it is felt, would have provided a much clearer picture, and useful when conducting statistical analysis. The use of scatter plot charts and small untenable population samples within county council/county borough areas, did produce the odd 'flier.' For example one area, had ten births within the three year period studied, one of these was a low birth weight birth, which produced a skewed result of 10% low birth weight births for that area. Generally results of analysis with both the Jarman Index and the Townsend Score, show mild but significant, simple correlations between low birth weight and deprivation which may have given a clearer picture, had a full data set been available.

### Further work

It is intended to further clarify and develop issues raised in this paper when new complete data sets become available. The findings of this study will be used to provide focus for further work in the Rhyl area.

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