



Developing the Public Health Observatory for Wales

Datblygu Arsyllfa Iechyd y Cyhoedd i Gymru

Measuring childhood heights and weights in Wales

**Report to the Welsh Assembly
Government to inform the Minister for
Health and Social Services on the
findings from a study to explore the
feasibility of a national measurement
programme and recommendations for
future rollout across Wales**

MAIN REPORT

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Authors: Public Health Observatory for Wales	Page: 1 of 89	

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Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 2 of 89	

Contents

EXECUTIVE SUMMARY	9
RECOMMENDATIONS.....	14
1.1 The creation of a national measurement programme	14
1.2 Requirements of a national measurement programme	15
1.3 Organisation of a national measurement programme	18
1.4 Future work.....	19
2 PURPOSE.....	21
3 INTRODUCTION.....	22
3.1 Height, weight and body mass index in children	22
3.2 Classification of BMI in children	25
3.3 What causes obesity?	26
3.4 Why is obesity a problem?	28
3.5 Information on obesity among children in Wales.....	29
3.6 Obesity in Wales: new information a national programme could supply	34
4 DEVELOPMENT OF THE STUDY.....	35
4.1 Population surveillance vs. population screening.....	35
4.2 Legal considerations	36
4.3 Requirements of the study	36
4.4 Preparing for the pilot study	37
4.5 The study steering group	42
4.6 Key agreed aspects of the programme to be piloted.....	42
4.7 Constraints.....	43
4.8 Ethical approval	44
5 AIMS AND OBJECTIVES.....	45
5.1 Aim.....	45
5.2 Objectives	45
6 METHODOLOGY.....	46
6.1 Measuring children's height and weight: the pilot.....	46
6.2 Study design	48
6.3 Study Power.....	49
6.4 Height, weight and related data	49
6.5 Interviews with children, parents and staff	51
6.6 Providing BMI results to parents, and its impact	56
6.7 Cost assessment	58
6.8 Literature review	59
7 RESULTS	60
7.1 Results of measurement of children's heights and weights	60
7.2 European surveillance	71
7.3 Interviews with children, parents and staff	71
7.4 Providing BMI results to parents, and its impact	73

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 3 of 89	

7.5	Other qualitative feedback	76
7.6	Cost Assessment	76
7.7	Literature review	78
8	DISCUSSION.....	80
9	CONCLUSIONS.....	82
9.1	Feasibility of measuring children's heights and weights in schools for population monitoring	82
9.2	Quality of data.....	82
9.3	Uptake of measurements (response rate).....	83
9.4	Proportion of children overweight or obese.....	83
9.5	Attitudes towards measuring programme.....	84
9.6	Providing results of measurements.....	85
9.7	Impact on services	85
9.8	Participation in European Childhood Obesity Surveillance Initiative	86
9.9	Cost assessment	86
10	REFERENCES.....	87

Appendices are contained in a separate document

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 4 of 89	

Table of figures

Figure 1. Prevalence of excess body fat, including obesity, among 13 year olds in countries of the World Health Organisation, European Region, 2001-2002	31
Figure 2 Prevalence of excess body fat, including obesity, among 15 year olds in countries of the World Health Organisation, European Region, 2001-2002	32
Figure 3. Materials used when talking with the children	53
Figure 4. The weighing and measuring game	53
Figure 5. Photographic prompt of the scale used in the weighing and measuring pilot.....	54
Figure 6. Playing with the hideaway rabbit puppet	55
Figure 7 The book was used to clarify the child's understanding of feelings	55
Figure 8. Distribution of BMI results (BMI < 50), reception year	62
Figure 9. Distribution of BMI results (BMI <50), year 4.....	62
Figure 10. Percent overweight or obese* by local authority**, reception year	67
Figure 11. Percentage overweight or obese* by local authority**, year 4 opt-out.....	67
Figure 12 Percent overweight or obese* by local authority**, year 4 opt-in.....	68
Figure 13. Percentage of children overweight or obese by WIMD fifth of deprivation, reception year	70
Figure 14. Percentage of children overweight or obese by WIMD fifth of deprivation, year 4.....	70

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 5 of 89	

Table of tables

Table 1: The WHO International Classification of adult underweight, overweight and obesity according to BMI.	24
Table 2. Sources of data on obesity among children in Wales.....	30
Table 3. Guidance on children's height and weight measurement in selected countries.....	38
Table 4. Key aspects of the programme to be piloted	42
Table 5. Percentage of records complete and within a valid range by pilot site	61
Table 6. Records with a BMI within the valid range* by pilot site	61
Table 7. Percentage of children* where a height or weight measurement was recorded by school year and trust, NCCHD	64
Table 8. Percentage of records where a height or weight measurement was recorded by trust, reception year children, European forms.....	64
Table 9. Percent underweight, normal weight and obese by age group, all children.....	65
Table 10. Percent underweight, normal weight and obese by age group, boys.	65
Table 11. Percent underweight, normal weight and obese by age group, girls.	65
Table 12. Percentage of children overweight or obese* WIMD fifth of deprivation and school year**	69
Table 13. Proportion of parents requesting results of measurements	73
Table 14. BMI category by gender among children whose parents requested results, Pembrokeshire.....	75
Table 15. Costs by area, excluding costs of feedback of results to families	77
Table 16. Estimated cost per 1,000 children measured*	77

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 6 of 89	

Abbreviations

BMI	Body Mass Index
CCH2000	Community Child Health System 2000
HBSC	Health Behaviour of School Aged Children
HSW	Health Solutions Wales
GP	General practitioner
IOTF	International Obesity Task Force
NCCHD	National Community Child Health Database
NICE	National Institute of Health and Clinical Excellence
NCMP	National Child Measurement Programme (England)
NSC	National Screening Committee (UK)
NPHS	National Public Health Service for Wales
PCT	Primary care trust (England)
WHO	World Health Organisation
WIMD	Welsh Index of Multiple Deprivation

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 7 of 89	

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Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 8 of 89	

Executive summary

The National Public Health Service for Wales (NPHS) was requested by Mrs Edwina Hart, AM MBE Minister for Health and Social Services for the National Assembly for Wales, to undertake a study into the feasibility of measuring children's heights and weights in Wales. The work is intended to inform the development of a standardised national measurement programme of children's heights and weights in Wales.

Importance of overweight and obesity

There is a background of rising levels of overweight and obesity in both adults and children. Childhood rates in Wales appear to compare poorly to many other areas in Europe. The individual adverse health consequences of overweight and obesity in adults are understood. Obesity is a risk factor in many chronic diseases and is overtaking smoking as a preventable cause of disease and premature death. Adverse health social and psychological effects of obesity are now being seen among children as well as adults.

Although it is known, from surveys, that overweight and obesity has been rising in children in Wales, little is known about the geographical and social distribution. There is also no reliable information about whether overweight or obese children remain that way throughout childhood or not.

Nature of measurement programme

Prior to commencing the study, the purpose of any future measurement programme required clarification. The purpose of the study was agreed to be to test the feasibility of introducing a population surveillance rather than a screening programme. Population surveillance differs from screening in that it gathers information about the population to inform action at that population level, whereas screening is a test to determine whether further intervention is offered at an individual level. The UK National Screening Committee has advised that there is not enough evidence in relation to potential benefits and harm to introduce a screening programme for obesity at present.

Outline of study and methods used

The overall study involved a number of pieces of work, including:

- Background scoping and information gathering including literature reviews
- Piloting measurement procedures across five geographically dispersed areas of Wales served by different Trust based school health services. This study

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 9 of 89	

included 30% of eligible population of children in Wales in reception year (4 - 5 years of age) and year 4 (8 – 9 years of age). It specifically tested:

- The feasibility of undertaking a measurement programme associated with school health services
- The feasibility of using existing school healthy databases to record measurements
- The implications of using different approaches to parental consent (opt in or opt out) for year 4 pupils. This was done using random allocation of schools to each approach and then assessing the impact of each approach on acceptability, uptake of measurements and overall measures of overweight / obesity.
- The views of children, parents and staff on the acceptability of testing were sought through an associated qualitative study undertaken by Swansea University.
- The impact on other health services of introducing a national measurement programme (assessed by identifying contacts with NHS direct and with GP (general practitioner) practices in one of the areas).
- Relevant information on costs was also collated to inform future decisions concerning a national measurement programme.

A Steering Group was established to oversee the project and ethical approval was gained for the research elements of the study. A study protocol was developed, staff were trained and children were measured in March and April 2009.

Results

Overall, the study showed that it was feasible to monitor the heights and weights of children in reception and year 4 school years and provide robust surveillance data in Wales. The *opt out* option for parents had much higher participation which in turn contributes to more robust results. Data could be analysed at Local Authority level.

- Uptake of measurements

The uptake of measurement was very high in reception aged children with 92.8% of eligible children measured and valid results recorded. This compares with rates of uptake in England of 48% in 2005/6 and 82% in 2006/7 (Crowther et al, 2007; Dinsdale, 2008). The uptake of measurement in year 4 children was lower and varied according to whether parents were offered the choice of *opting out* of the measurement or *opting in*. Of those eligible for measurement in the *opt out* group 89.3% of children were measured with valid results recorded. Of those eligible for measurement in the *opt in* group, 68.5% of children were measured with valid results. This

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 10 of 89	

compares with rates of uptake in England of 48% in 2005/6 and 77% in 2006/7 for year 6 children (Crowther et al, 2007; Dinsdale, 2008).

- Levels of overweight and obesity

The study confirmed previous concerns about the prevalence of overweight or obese children. In reception year the rate of overweight or obese children was 22%, for year 4 *opt out* group was 28.5% and for year 4 *opt in* group was 26.4%. The lower rates for the *opt in* groups were generally consistent across the geographical areas. Although not statistically significant, it may be an important indicator that parents of overweight or obese children are less likely to participate. Children living in the most deprived areas of Wales had statistically significantly higher rates overweight and of obesity than children living in the least deprived areas.

- Acceptability of testing

Some improvements to the measurement programme were identified through interviewing children measured, particularly with regard to privacy and being accompanied by a familiar adult. There was a sense from many parents that it was expected that children would have their height and weight measured at school. Both children and parents expressed an interest in knowing the results of measurements.

Staff implementing the programme and some parents were aware that the purpose of the programme was population monitoring but had difficulties separating this from managing individual children. Staff, in general, had more concerns over whether consent was *opt in* or *opt out* than parents.

- Impact on workload

Participating staff found the programme was work intensive, especially providing feedback. There was no discernable adverse impact on the workload of GP practices in the area assessed by survey. A dedicated NHS Direct telephone helpline and online resource was offered to more than 1,700 parents who received feedback but there was minimal follow up by parents with less than 20 contacts for the phone line and website combined.

- Resource Implications for future programme

A cost assessment exercise was carried out to assess the resource implications of implementing the surveillance programme. Costs per 1,000 children measured was estimated as between £3,300 to £6,800 in rural areas and between £1,900 to £5,400 in urban/mixed settings. Although cost of taking the measurements per 1,000 children was higher in rural areas, other staff costs, for example time spent entering the data on the child health system, were very influential on the estimated costs for each service. Additional central costs for coordination, data analysis, reporting and

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 11 of 89	

evaluation would also contribute to the overall cost of implementing a surveillance programme across Wales.

Implications for future national measurement programme

The study showed that the introduction of a surveillance programme is feasible in Wales. Various options for delivery of the programme can be identified. It is recommended that the preferred model would be a managed data collection system involving delivery by local health care organisations, but with:

- publication of standards for measurement and data collection, stating organisational responsibilities;
- a requirement on health organisations to fulfil those standards, including identifying local coordinators for the programme;
- central co-ordination of data collection, with a lead individual in a lead agency responsible for liaising with local coordinators to ensure data are collected in accordance with the national standards;
- central provision of training, standard wording for letters, information sheets and support materials; optionally central provision of equipment;
- optionally, specific targets for health organisations to ensure the standards are met;
- modification and utilisation of existing child health computer systems to capture, collate and analyse data.

If a national programme is introduced there should be central coordination to ensure the quality of the programme including data analysis and reporting. Information from such a programme should be regularly analysed, published, disseminated and evaluated.

An area that was considered of particular interest was giving results of measurements to parents. Three areas routinely offered parents the results of the measurements. There was relatively high uptake for receiving the results, especially in the opt-in measures (due to the ease of 'ticking the box' when return the form for measurement). Parents were generally satisfied with the format in which results were given. Although parents said they would go to a GP if their child was over- or under-weight, there is no evidence from this study that parents did seek assistance from the health service. The method involved in giving results back in this study was resource intensive. This study could not assess the balance of benefit and harm in routinely providing such results to families. If results are to be provided as part of a national programme, consideration should be given to the automation of this process.

Areas for further work

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 12 of 89	

Further thought will need to be given to the rights of parents in allowing their children to participate and for feedback and the relative benefit of each. An *opt out* approach to measurement substantially increased the uptake giving more accurate prevalence data which may improve the identification of health inequalities. Some children have indicated a wish to know their heights and weights at the time of the measurements and consideration will need to be given as to how to do this in a way they understand that will not cause any distress.

Recommendations

These recommendations are based on the conclusions of the feasibility study undertaken by the National Public Health Service for Wales and partner organisations. They relate to the introduction and implementation of a national programme of height and weight measurement in primary schools in Wales. The purpose of any such programme would be to describe population prevalence of underweight, overweight and obesity, at national and local authority levels.

1.1 The creation of a national measurement programme

Although the study aimed to explore the feasibility of a national measurement programme, nonetheless, work in developing and implementing this study can help to inform whether or not a national measurement programme should be established.

1. **A national measurement programme should be introduced in Wales.** Obesity represents a major public health challenge for Wales. Although height and weight measurements are taken in primary schools across Wales, it is currently impossible to obtain national information on childhood obesity from these measurements.
2. **As a minimum this programme must include the standardisation of height and weight measurement in at least one age group.**
3. **The programme should allow reporting of prevalence trends of underweight, overweight and obesity that are comparable across Wales and with data produced internationally.**
4. **The programme should include height and weight measurements to be undertaken in a standard way in reception year (age 4/5).** Currently measurements are taken in either reception year or year one across Wales. Measurement in reception year would allow comparison with the National Child Measurement Programme in England (reception year) and primary 1 measures in Scotland.
5. **The programme should include height and weight measurement in a second age group.** If data is linked across the two age groups it would allow not only for information across a broader age range, but also understanding as to how weight changes with individuals over time.
6. **A second age group of year 4 (age 8/9) is recommended as part of the programme.** This would allow comparisons to be made across Europe as part of the World Health Organisation European Childhood Obesity Surveillance Initiative. The European surveillance is based on a national sampled method every two years. Participation can be undertaken at a whole population level, which would allow local authority level data to be acquired. **Consideration should be given as to whether the data would be collected annually using a whole population approach, or using sampling methods every**

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 14 of 89	

two years. Potential resource implications of introducing a population measurement approach in year 4 are described. The approach taken would have implications for the organisation of a national programme (see section 19).

7. The programme will require agreed standardised procedures for consent for measurement and feedback of results (see later).
8. Measurement of waist and hip circumference was beyond the remit of this study. However, due to increasing evidence for the relationship between these measurements and health, the European Childhood Obesity Surveillance Initiative collects these data as optional items. **If participating in the European Childhood Obesity Surveillance Initiative, consideration should be given to the collection of waist and hip circumference on a sample of children.**
9. **The National Screening Committee guidance on screening for short height should be implemented as part of any national programme,** using the recommended threshold of the 0.4th centile for height.
10. **While maintaining national standards, the programme should be sufficiently flexible to avoid unnecessary disruption of local good practice.** For example, if height and weight measurements are taken as part of a school health interview, duplication of measurements should not be required.

1.2 Requirements of a national measurement programme

A national measurement programme should ensure standardisation of more than just the age of the children to be measured.

11. **Minimum standards should be set for undertaking measurements.** These should include standards relating to:
 - **staff training:**
 - taking of accurate measurements,
 - recognising and responding to health and welfare concerns among children,
 - communicating with children;
 - **instruments** to be used and their calibration. Ideally the model of instrument used should be standardised throughout the programme. Alternatively, a minimum standard should be set, such as compliance with EU Directive 90/384/EEC, with annual calibration;

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 15 of 89	

- the **environment** in which measurements take place, in particular
 - privacy for children, including consideration that, wherever possible, they are taken individually to a private weighing and measuring room directly from the classroom, rather than from a 'holding area' and
 - that children are allowed to be accompanied by someone familiar to them if they wish;
 - **communication** including
 - adequate processes to ensure children and parents are properly informed about the programme, including storage and use of the data,
 - involvement of teachers to inform children about what will happen and crucially, why. This approach could be incorporated through the *Wales Network of Healthy School Schemes*,
 - ensuring staff undertaking height and weight measurements tell children who they are, what their role is and remind children what is happening;
 - **local quality assurance systems.** These should include review of data items to identify obvious errors and, if participating in the European surveillance, ensuring each school has the appropriate form returned, and that these are correctly completed. These should be linked to national quality assurance processes.
12. **Any population coverage measurement programme should be recorded on the Community Child Health (CCH) 2000 System, and included in the National Community Child Health Database (NCCHD).** This would allow for national longitudinal analyses (follow-up of the changes that occur in individuals) without identifying any individual within the study (*pseudonymisation*).
13. **Minimum standards should be developed for data recording and entry.** This should include standard operating procedures and specification of the data items to be collected, definition of those data items and specification of the data fields to be used. **This should include robust systems to ensure uptake rates can be clearly calculated including ensuring that school registers are checked to update the information held on CCH2000 for the relevant years.**
14. **The CCH2000/NCCHD should be amended** in order to minimise additional effort for data entry staff, and maximise the usable information collected. Amendments would be required to be able to use these systems as part of the

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 16 of 89	

European Childhood Obesity Surveillance Initiative. Such amendments include:

- A dedicated data entry screen for the programme
- Development of appropriate consent options within the data entry screen for height and weight.
- For participation within the European Childhood Obesity Surveillance Initiative: inclusion of additional fields required as part of mandatory data collection.

15. **The approach to parental consent should be standardised.** Different approaches to consent will give rise to differential up take rates, which in turn may affect the measured prevalence of underweight, overweight or obesity. This study suggests that an **opt-out** approach (i.e. a child is included in measurements unless the parent returns a form to 'opt-out' of measuring) substantially increases uptake of measurements and is expected to give rise to more accurate prevalence data. In this study measured obesity was lower (underestimated) where an opt-out approach was not used; however, in this study the difference was not statistically significant. Consideration needs to be given to the balance between potential benefits of an **opt-in** (where a child is only measured if a parent returns a form explicitly agreeing to measurement) approach, in particular that engagement with families may be higher, and the disadvantages of this approach in terms of achieving the aims of the programme.

16. The purpose of population height and weight measurement examined for this study was to monitor prevalence of obesity using body mass index (BMI). It was not in order to identify obesity in any particular child, nor to instigate any response based on the BMI measure for a child. A programme with this purpose would be a screening programme; screening programmes have potential harms as well as potential benefits. The United Kingdom National Screening Committee advises screening for childhood obesity should **not** be offered. **Any future programme should not use BMI results of an individual child as a threshold for an intervention aimed at benefiting that child**, as this would, in essence, be a screening programme.

17. Parents and children have an interest in knowing the results of measurements taken. Parents were generally content with the format of results they were given. However, giving results to parents has direct costs for the health service and it is unclear whether parents take any action as a result of receiving those results. There is evidence from this study that parents do not seek support from health services in response to the results received. **It is recommended that if resources allow, parents have the right to request the results of the measurements and that those results should include the BMI and its interpretation; however, it is recommended that parents are not given the results if they have not requested them.** The method by which parents are offered this option (e.g. a tick box as part of an 'opt-in' or a

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 17 of 89	

statement as part of covering information) may substantially affect the numbers of parents requesting results. The way in which parents are offered the results should be considered carefully.

18. If offering parents the **results of measurements** which include BMI, then

- systems should be explored **to allow automated generation of letters**, while ensuring ultimate responsibility for the clinical content of any letter remains with clinical staff within the Trust,
- **amendments to the CCH2000** should include the ability to record a parent's wish to receive the results at the time of data entry,
- any **letter** should make it clear that BMI is imperfect, and should be used in the context of other information when being interpreted for an individual child,
- adequate **information to address concerns that may arise in relation to a child's BMI should be included with the results**; very few parents will seek further information from healthcare sources.

19. Information from any national programme should be centrally analysed, published and disseminated on a regular basis. In particular, NCCHD capacity to examine relationship of height and weight data to other factors, including deprivation, should be undertaken.

20. **National coordination and quality control processes are required for the programme.**

1.3 Organisation of a national measurement programme

A number of options exist for the organisation of a national measurement programme

21. **Data collection of whole population measurements of a specific age group (reception year, and possibly year four) should use a managed data collection system approach.** This (option 3) is recommended in order to produce a coherent national programme without undermining local services. The success of option 3 depends on good partnership working between agencies and a robust management approach. Two alternative options for data collection are described in Box 1.

22. **If undertaking a sampled approach to data collection in year 4**, then a minimally co-ordinated approach for this group would not be feasible; **a fully centralised data collection system would be preferable.**

23. Given the usual role of school/community nurses, including measurements currently being undertaken by these services across Wales, any approach to whole population measurement should be undertaken by school/community nursing services. A sampled approach would require separate mechanisms.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 18 of 89	

- 24. There should be robust mechanisms for engagement with education services at every level to ensure effective running of the programme.** In addition to more general support, particular mechanisms should be explored for the provision of up to date school lists, including important variables such as the ethnicity of the child and ensuring private areas for weighing and measuring are made available.
- 25. There should be an agreed programme of publication and dissemination of data and information from the programme.** This should involve three distinct mechanisms: (1) agreed data tables and routine monitoring information should be routinely done centrally; this may fit well with the role of the NCCHD; (2) more in-depth public health analyses and interpretation relating to obesity in Wales should be undertaken by the Public Health Observatory for Wales (3) Cleaned datasets in keeping with information governance requirements, suitably anonymised, should be made available to a variety of organisations including the World Health Organisation (if participating in the European Childhood Obesity Surveillance Initiative), and academic institutions.

1.4 Future work

- 26. The monitoring programme should be evaluated after a specified period of implementation,** e.g. three years, to assess in particular (1) data quality; (2) availability of information; and (3) how the information produced has been used.
- 27. Further research** should be undertaken in respect of the potential benefits and harms of routine feedback of height and weight data to parents.
- 28. Further analyses should be undertaken** of the pilot data to explore the relationship of obesity with other factors that can be linked to the National Community Child Health Database; consideration of calculation of UK 1990 centile based obesity prevalence and analysis of the European mandatory school form.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 19 of 89	

Box 1. Options for organisation of data collection systems for population measurements

Option 1. A fully centralised data collection system

This would involve:

- a single, central organisation responsible for data collection;
- central employment of all staff involved in the measurement programme including those staff: undertaking measurements, supervising measurements, entering data, cleaning and analysing data, producing and publishing the findings of the programme;
- central purchasing of equipment and provision of training;
- central production of letters and information sheets to parents and support materials.

This approach would have specific data governance issues if data were not collected within health service settings. This approach could undermine existing programmes of height and weight data collection. This approach is likely to be the most costly approach.

Option 2. A minimally co-ordinated data collection system

This would involve:

- publication of standards for data collection, stating organisational responsibilities;
- a requirement on health organisations to develop local mechanisms to fulfil those standards, including development of local training programmes, and may include local development of information sheets and support materials;
- mechanisms for assessing that the standards have been met, such as specific targets.

This approach risks inconsistency in data collection and the identification of deficiencies in data collection may occur too late within the process to allow these to be addressed in a timely manner. This approach requires the least amount of central coordination.

Option 3. A managed data collection system

This would involve:

- publication of standards for data collection, stating organisational responsibilities;
- a requirement on health organisations to fulfil those standards, including identifying local coordinators for the programme;
- central co-ordination of data collection, with a lead individual in a lead agency responsible for liaising with local coordinators to ensure data are collected in accordance with the national standards;
- central provision of training, standard wording for letters, information sheets and support materials; optionally central provision of equipment;
- Optionally, specific targets for health organisations to ensure the standards are met.

This approach is less costly than option 1, but is expected to produce a national programme which is more consistent across Wales. The information produced is expected to be more reliable with problems being identified and addressed at an earlier stage.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 20 of 89	

2 Purpose

This document is intended to inform Mrs Edwina Hart, AM MBE, the Minister for Health and Social Services of the details of the feasibility study measuring children's heights and weights in Wales, the resultant findings and to propose recommendations for rollout across Wales

The requirement for a feasibility study is outlined in a programme level agreement between the Welsh Assembly Government and the National Public Health Service for Wales (Welsh Assembly Government 2008):

“The National Public Health Service (NPHS) is asked to undertake a feasibility study in 2008-09 for the creation of a national measurement programme of children's height and weight.

Any such programme would be used to:

- Monitor trends in childhood obesity in order to inform strategies and service development;*
- Assess the effectiveness of population based interventions;*
- Provide the basis for population based epidemiological research.”*

The study was undertaken in five NHS Trust areas across Wales between December 2008 and May 2009, involving primary school children in reception, aged 4-5 years, and year 4, aged 8-9 years.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 21 of 89	

3 Introduction

3.1 Height, weight and body mass index in children

Growth has been used for a long time as a measure of young children's health and wellbeing. Height and weight in isolation are useful tools for assessing the growth of an individual child. They can be used to alert clinicians that a child has faltering growth, indicate a growth disorder and suggest problems with weight gain or loss. In this context *serial measurements* of an individual child over time are often used to understand the pattern of growth for that child.

Assessing an individual's weight, without taking account of their height, may be misleading. For this reason the body mass index (BMI) has been developed. The formula for BMI is:

$$BMI = \frac{weight(kg)}{height(m)^2}$$

For example, an adult who weighs 70kg and whose height is 1.75m will have a BMI of 22.9.

$$BMI = 70 \text{ kg} / (1.75 \text{ m})^2 = 70 / 3.0625 = 22.9$$

Body mass index is used to understand weight in relation to height, and in particular to describe overweight and obesity, and also underweight (or 'thinness').

A child's height, weight and BMI will change in accordance with their age, and be different for boys and girls of the same age. Because of this a height, weight or BMI measurement should always be interpreted in relation to their age and gender, usually by using a centile chart. Centile charts allow a child's growth to be compared in relation the normal growth of a population (Underdown, A, 1999)

3.1.1 What is underweight?

The human body requires energy to grow and function. This energy is consumed in the form of food and drink. The body breaks down the food and drink by the process of metabolism to release energy. The energy produced is used for metabolism, cell growth and repair and also to fuel physical activities such as exercise, sleeping and breathing. If the energy consumed is greater than the body uses, it is stored as fat. If the body uses more energy than it consumes, it calls on these fat stores for energy.

Faltering growth is not a disease but an observation that a child is growing exceptionally slowly. This can reflect serious underlying problems, and if unresolved may result in stunted growth and delayed development, although the long term effects are not clear. It is thought that as many as 5% of children under five will experience an episode of faltering growth at some time.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 22 of 89	

Faltering growth was historically termed failure to thrive and children are considered underweight if they fall below the 0.4th centile on the centile chart for their age.

Children can experience poor growth due to a number of causes:

- Decreased appetite as a result of illness
- Inadequate dietary planning - for example due to dietary misconceptions, late weaning, inappropriately restricted diets
- Inadequate feeding - feeding difficulties, family social or emotional difficulties
- Rarely, the inability to absorb nutrients, for example, coeliac disease, cystic fibrosis, food intolerances, upper gastrointestinal obstruction
- Chronic conditions, for example, asthma, chronic infection, cerebral palsy, congenital heart disease
- Higher energy requirements as a result of increased metabolic rates or activity levels (Underdown, A, 1999).

Faltering growth is usually identified through regular monitoring of a child's weight to identify trends in growth or in weight loss. This is routinely done in primary care settings by midwives and health visitors or in school through the school health service.

There has been confusion between differing term such as wasting, failure to thrive, faltering growth and underweight. A new definition of "thinness" for children was proposed (Cole et al, 2007) which was based on World Health Organisation BMI categories in adults and was developed for international use and comparison. Cole proposed three grades of thinness corresponding to the WHO graded definition of thinness and specific to the exact age of a child. These can be used as part of clinical assessment and consideration of further intervention, as appropriate.

3.1.2 What is obesity?

Excess body fat will accumulate if the body consumes more energy that it uses over a prolonged period. Obesity can be defined as a condition in which excess body fat has accumulated to such an extent that health is adversely affected (Muller, 2008).

The World Health Organisation (WHO) International Classification of adult underweight, overweight and obesity according to BMI is shown in Table 1. There are also sub divisions within each classification (WHO1995, 2000 and 2004).

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 23 of 89	

Table 1: The WHO International Classification of adult underweight, overweight and obesity according to BMI.

Classification	Adult BMI
Underweight	Less than 18.50
Normal	18.50 – 24.99
Overweight¹	25 +
Obese	30.00 +

Source: adapted from WHO 1995, 2000 and 2004

Although BMI is the most widely used and accepted measure of overweight and obesity, there are some limitations in its sensitivity, that is, its ability to correctly identify individuals who are overweight and obese, and its specificity, that is, its ability to correctly identify those who are not overweight or obese (McCarthy et al, 2003; Sweeting, 2007). In particular:

- Muscle density – although weight is generally a good indicator of body fat, some individuals may be categorised as overweight or obese as a result of greater muscle density e.g. body builders.
- Waist circumference – the distribution of fat on the body is important in relation to the risk of morbidity or ill health. Central body fat, as measured by waist circumference, is associated with greater morbidity. A study of British children aged 11-16 years in 1977, 1987 and 1997 showed that trends in waist circumference exceeded those in BMI, systematically underestimating the prevalence of obesity in young people (McCarthy et al, 2003).
- Ethnic differences – many Asian races have a higher percentage of fat mass than Caucasians (white races), while black African races have a lower percentage of body fat. Using BMI may underestimate obesity in some Asian races and overestimate in black African races.
- Children's measurements – BMI varies with gender, age and level of physical maturity. Male and female BMIs are similar in childhood but higher in female adolescents. Also, BMI usually increases from birth to one year, decreases to age six and increases through the remainder of childhood and adolescence. It is therefore more difficult to assess the significance of BMI in children and adolescents than in adults. This is further complicated due to the more arbitrary level that children are defined as overweight or obese (see section 3.2).

¹ The overweight category includes the obese category. For ease of reading and clarity the term 'overweight or obese' is used instead of the more precise terms 'overweight, including obese' or simply 'overweight'.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 24 of 89	

Despite these limitations, BMI is accepted internationally as a good measure at a population level, to monitor trends in overweight and obesity.

3.2 Classification of BMI in children

Among adults, standard BMI cut-offs have been established for overweight and obesity related to health outcomes; However, there is no universally accepted classification of normal BMI among children.

A number of different BMI classification systems for children are in place

1. UK 1990 centile ranges. These are widely used in the UK. They do not directly relate to the accepted adult cut-off ranges, and can only be used for UK data.
 - a. Clinical ranges. The National Institute for Health and Clinical Excellence (NICE, 2006) recommends the use of the 1990 UK BMI centile chart in clinical practice with:
 - i. Overweight cut off: 91st centile
 - ii. Obese cut off: 98th centile
 - iii. The 2nd centile is marked on these charts, and may be used (though not a NICE recommendation) as a cut off for underweight.
 - b. 'Epidemiological ranges'. These ranges have been used in a number of population studies in the UK. They are used by the Welsh Health Survey and are currently used by the National Child Measurement Programme in England. This cut-off cannot be used to compare prevalence rates with rates undertaken outside of the UK. This uses a relatively wide range in the 'underweight' category, and so both the Welsh Health Survey and National Child Measurement Programme (England) classify greater numbers of children as being obese than overweight among some age groups; a pattern very different from that seen in adults in the UK.
 - i. Overweight cut off: 85th centile
 - ii. Obese cut off: 95th centile
 - iii. There is no clear cut-off for underweight; although the National Child Measurement Programme uses the 2nd centile.
2. International Obesity Task Force. These ranges have been developed to allow international comparisons. Unlike the UK centile charts they are designed to match up with adult BMI cut-offs at age 18. This is based on data from six countries including Great Britain. These cut-offs have been widely used in published data both within the UK (and Wales) and internationally.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 25 of 89	

- i. Overweight is based on a cut-off matching with a BMI of 25, age 18
- ii. Obese is based on a cut-off matching with a BMI of 30, age 18
- iii. A separate proposal by the same author, Cole *et al.*, categorises underweight (thinness) linked to a BMI of 17 at age 18 (grade II thinness in adult WHO cut off); this cut-off closely mirrors the 2nd centile on the UK 1990 growth charts in the ages 4-9.

3. World Health Organisation

- a. WHO child growth standards birth to 5 years (2006). The Department of Health with the Royal College of Paediatrics and Child Health have endorsed use of a UK WHO birth to 4 years chart from May 2009. These charts incorporate the WHO growth standards for breastfed babies for clinical practice. In children aged 2-4 the following is recommended on these charts:
 - i. Overweight cut off: 91st centile
 - ii. Obese cut off: 98th centile
 - iii. 'BMI below the 2nd centile is unusual and may reflect under nutrition'
- b. WHO growth reference data 5-19 years of age (2007). Most likely due to the recent publication of these ranges, little has been published using these reference ranges at this time.
 - i. Overweight > +1 standard deviation, equivalent to a BMI of 25 at age 19
 - ii. Obese > +2 standard deviations, equivalent to a BMI of 30 at age 19
 - iii. Thinness (underweight) <-2 standard deviations (this closely relates to the underweight described by Cole linked to a BMI of 17 at age 18).

3.3 What causes obesity?

On a simple level obesity develops as a result of intake of more energy in the form of food and drink than the body uses. The Foresight Programme – *Tackling obesity: future choices* is a research programme of the UK Government Office for Science. The Foresight Programme was asked to consider how society might deliver a sustainable response to obesity over the next 40 years. Foresight (2007) has

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 26 of 89	

produced a map of the obesity system, identifying a multitude of influences on the energy balance:

- Biology e.g. genetic factors, appetite control mechanisms
- Impact of early life and growth patterns e.g. mother's diet while pregnant, breastfeeding, weaning practices and early dietary habits
- Behaviour, in particular:
 - Eating - motivation and health related behaviour is complex e.g. the conflict between what people want e.g. fatty, sweet foods and the desire to eat healthily and be slim
 - Physical activity - this is influenced by social and cultural factors. Physical activity has declined with less manual jobs, increased car ownership and labour saving devices and sedentary behaviours such as television viewing. Other behaviours such as parental fears about unsupervised play and travel to school may also play a role.
 - Wider cultural and social context e.g. organisational cultures, social processes and the media influence individual behaviours. There is evidence that lower educational attainment and socio-economic status and mental illness are associated with obesity and that the obese face considerable discrimination.
 - Additional psychological factors e.g. habits, beliefs, translating intention into action, moral climate.
- The living environment, i.e. those environmental factors that impact on energy intake and expenditure. These include:
 - Technologies, particularly advances that engineer out physical activities e.g. computer games, online shopping, home appliances.
 - Opportunities for physical activities – this is influenced by how we perceive our environment in terms of commuting distances, safety, availability and access, convenience, local knowledge and satisfaction, urban form, aesthetics and supportiveness of environments.
 - Food and drink access and availability e.g. supermarkets, takeaways, restaurants.
- Economic drivers include:
 - Price of food and drink as a proportion of household expenditure, this has generally dropped in the UK to an average of 10%, but can be as high as 23% for lower-income households.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 27 of 89	

- Food marketing, including, pricing, branding, positioning e.g. for impulse buying at checkouts, presentation, advertising, sponsorship, accessibility and market segmentation.
- Purchasing capacity and the impact on eating habits. As income increases people tend to eat out more frequently.
- Working practices appear to play a role with evidence of greater obesity in those who work longer hours.

The causes of obesity are complex, with interplay between these factors at both individual and population level. This is further supported by the National Institute for Health and Clinical Excellence (NICE, 2006) in their guidance on the prevention, identification, assessment and management of overweight and obesity in adults. Due to the complex nature of the causation of obesity, NICE recommend a broad range of measures to tackle the problem aimed at individual and population level.

3.4 Why is obesity a problem?

Obesity gives rise to two main problems:

3.4.1 Health consequences

The greatest consequences of obesity relate to the health of affected individuals. There is good evidence that obesity is a risk factor for many chronic diseases and is overtaking smoking as a preventable cause of disease and premature death. These include: type II diabetes, high blood pressure, breathlessness, restricted breathing during sleep (sleep apnoea), gall bladder disease, coronary heart disease or heart failure, osteoarthritis of the knees, gout, complications of pregnancy, cancer, impaired fertility, lower back pain, increased risk during anaesthesia and fetal defects arising from maternal obesity (Haslam D et al, 2006).

These are mainly disease of adults, but conditions such as type II diabetes, coronary heart disease, cancers, osteoarthritis and back pain also affect children. There are also social and psychological consequences of obesity such as stigmatisation, discrimination, prejudice, poor self image, low self confidence and depression (Parliamentary Office of Science and Technology, 2003).

3.4.2 Economic impact

The impact of obesity on the economy is significant. A study in Denmark (van Ball et al, 2008) estimated that obesity associated healthcare costs for people aged 20 to 56 years were higher than comparable costs for smokers or for healthy individuals. This suggests potential for reduced health care costs for these age groups if obesity prevalence is reduced. However the study also noted that the greatest lifetime expenditure was for healthy individuals due to longer life expectancy and consequent development of other conditions in later life.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 28 of 89	

Research was undertaken in the Republic of Ireland into the length of hospital stays and associated costs of obesity for children and adults. (Vellinga et al, 2008) The results showed that the frequency of hospital stays related to obesity increased from 1.14 per year in 1997 to 1.49 in 2004 for adults and from 0.81 to 1.37 per year for children. The number of days in hospital for obesity related conditions per 1000 days of hospital care given increased from 3.68 in 1997 for adults to 6.74 in 2004 and from 1.47 to 4.16 in children. Using 2001 costs for inpatient bed days, the cost of obesity related inpatient care was estimated as rising from 4.4 Euro millions in 1997 to 13.3 in 2004.

Further costs will also be incurred in primary care. Obesity can also have an economic impact on affected individuals as associated ill health may affect ability to work.

The World Health Organisation estimate that obesity accounts for between 2% to 8% of health costs in the European region and between 10% and 13% of deaths (WHO 2009).

3.5 Information on obesity among children in Wales

3.5.1 Sources of data on obesity among children in Wales

Until recently the self-reported health behaviour of school age children (HBSC) survey has been the only source of data on childhood obesity in Wales. In 2007 the Welsh Health Survey began measuring children's heights and weights on samples of children. Although the National Community Child Health Database (NCCD) has a remit to collect childhood height and weight data from each NHS Trusts Community Child Health System (CCH2000), efforts to estimate prevalence of obesity with the NCCHD have been unsuccessful (Table 2).

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 29 of 89	

Table 2. Sources of data on obesity among children in Wales

	Health behaviour of school age children	Welsh Health Survey	National Community Child Health Database (currently)
Data collection	Self reported	Measured; trained staff	Measured; variable training
Age	11; 13 & 15 years	2-15 years	varies - either reception or year 1; +/- one later year
Sample	1,500	2,000 (year 2007)	Whole population coverage
Comparator	39 other European region countries & United States of America	Health Survey for England, Health Survey for Scotland	potentially National Child Measurement Programme, England
First year available	1985/6	2007	-
Frequency	4 yearly, with interim report every 2 years	Annual	Yearly
Lowest geography	National	National	-
Comment	High level of non-response and self reported values undermines reliability	Reliable measures; Response 65% in 2007.	Efforts until now to gain a national picture of obesity from data have been unsuccessful

3.5.2 Health behaviour of school age children survey

The Health Behaviour of School Aged Children (HBSC) survey 2001 carried out by the World Health Organisation Office for the European Region shows Wales as the third highest rates of excess body fat, including obesity, for 13 and 15 year old adolescents, in the European countries taking part. Approximately 17% of girls and 25% of boys are overweight or obese, as shown in Figure 1 and Figure 2.

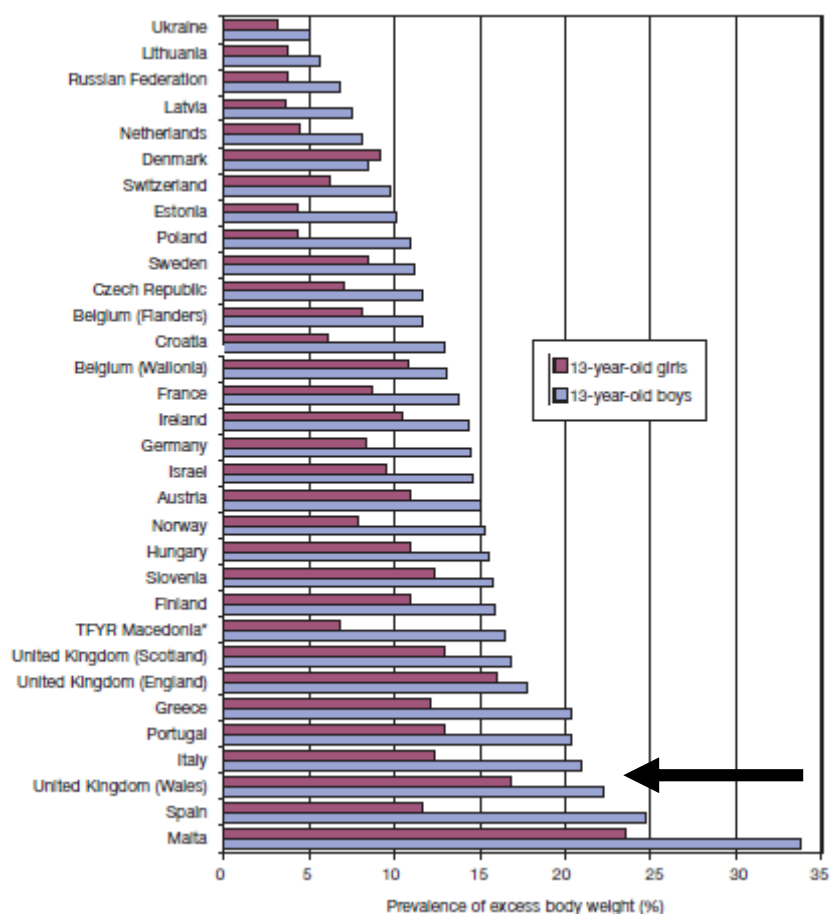
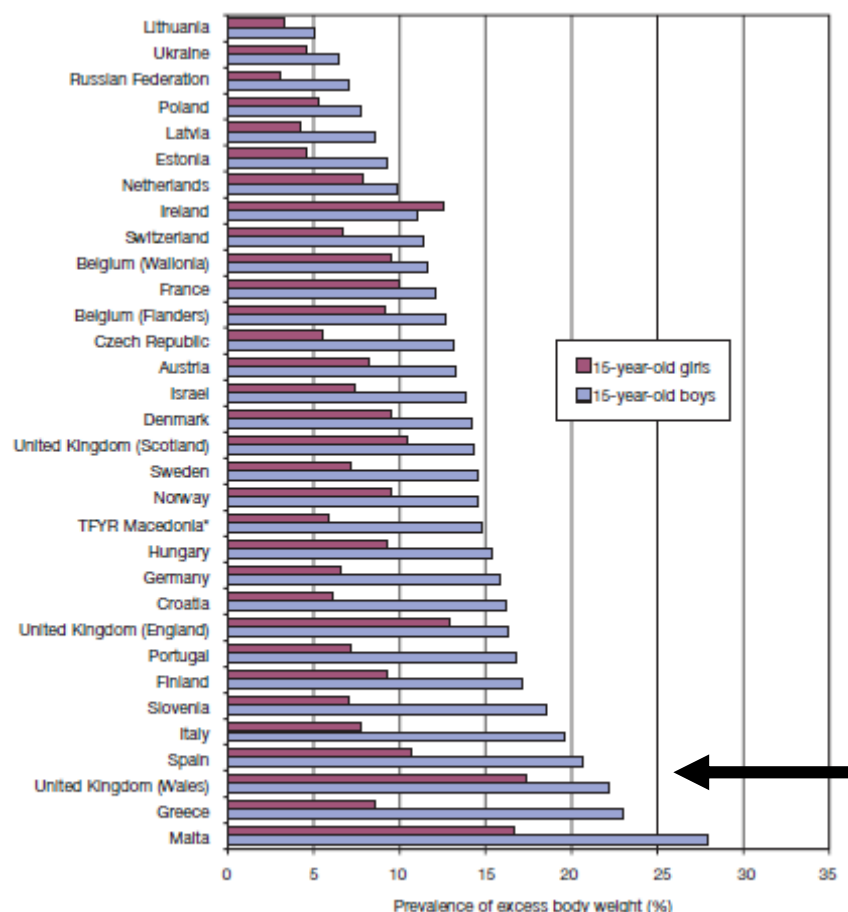


Figure 1. Prevalence of excess body fat, including obesity, among 13 year olds in countries of the World Health Organisation, European Region, 2001-2002

Source: Carroquino (2007) World Health Organisation

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 31 of 89	



*TFYR Macedonia – The former Yugoslav Republic of Macedonia

Figure 2 Prevalence of excess body fat, including obesity, among 15 year olds in countries of the World Health Organisation, European Region, 2001-2002

Source: Carroquino (2007) World Health Organisation

3.5.3 Welsh Health Survey

The Welsh Health Survey (Welsh Assembly Government, 2007) introduced height and weight measurements to calculate BMI. Although BMI results for children are primarily published using UK 1990 centile cut-offs, estimates using the IOTF cut-offs found overweight and obesity to be around 26%, including 7% obese (p 3). However due to the relatively small numbers in the survey it is not possible to analyse the data at Local Authority or locality level.

3.5.4 Community Child Health System 2000 / National Community Child Health Database

NHS Trusts in Wales measure the heights and weights of children through various child health programmes. This information is stored locally on the CCH2000 and can be collated through the NCCHD. Although a number of local studies have examined prevalence in a single Trust site, no study up until now has successfully obtained

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 32 of 89	

height and weight data for primary school measurements from the NCCHD from across Wales.

There is substantial evidence of the problems with data as it is currently collected in Wales.

A review of monitoring childhood obesity in Wales (Roberts & Fox, 2006) included a survey of the Professional Leads for Health Visiting and School Nursing in Wales across all community / school nursing services in Wales. This found that information on children's heights and weights are collected inconsistently, for example the age of measurement varies. Whereas all services measured height and weight at some point between age four and six years, the year group varied (reception year, year one, or at school entry). Three of these services undertook a second measure of height and weight at 11-12 years; and one of these took an additional measure at 13-14 years.

A number of local projects have assessed completeness of this information for different sites. A study of data held in Pembrokeshire on children aged 3, 6, (1987-2002) and 14 (1995-2003) found that 74% of the records had data that was considered complete and usable (Averill, 2004). A study in the Swansea area found that BMI coverage between 1986/7 and 2001/2 was between 87 and 99%, except for one year; and that 86% of these were considered usable (Jones et al., 2005).

Gully et al (2007) approached all 13 NHS Trusts in Wales and one Local Health Board, who routinely monitor height and weights of children to request anonymised data from 1998 to 2000. Only seven organisations responded with an average of 54% of children having records of height and weight, but at varying ages. Of these, 66% had a BMI recorded, 5% of these were invalid. The study concluded:

- A significant number of organisations holding data were unable or unwilling to divulge it
- Managers assumed heights and weights were being recorded
- There were wide variations in data quality and consistency of approach as to when and whether to measure children
- Many data items were missing
- Information was rarely fed back to clinical staff
- The quality of routine data collected was not fit for the purpose of surveillance of overweight or obesity in children.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 33 of 89	

3.6 Obesity in Wales: new information a national programme could supply

There is evidence that rates of obesity in Wales are worse than for many other European countries and that levels are rising for adults and children. However further useful information is unavailable in terms of:

- Consistent local information below the national level that can be used to inform action and monitor progress at population level.
- Information on other factors that may be linked to obesity within Wales such as deprivation, environment, or race.
- Effect of population based interventions to combat overweight and obesity.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 34 of 89	

4 Development of the study

4.1 Population surveillance vs. population screening

In developing the feasibility study it was essential to be clear on the purpose of the measurements being undertaken. There are two broad reasons to undertake a measure or test on a whole population, and these may be described in terms of population surveillance and screening.

Population surveillance is the ongoing systematic collection, collation and analysis of data with prompt dissemination of the information to inform action (Pencheon, D et al, 2001).

In this case it would be aimed at specific age bands of children throughout Wales. Population level information at both national and locality levels would be available. Although individuals are involved, data is anonymised, as the purpose is not to intervene at an individual level but to inform national policy, local action and to monitor outcomes.

Population screening is the systematic application of a test or inquiry (e.g. BMI) to identify individuals at specific risk who would benefit from further investigation or direct preventative action, who have not sought medical attention on account of their condition (Pencheon, D et al, 2001).

Since the causes of obesity are multi-factorial, any action to address the problem is likely to involve national policy and action by a range of organisations, agencies as well as the individual. It will involve cultural change. This is supported by NICE guidance and the Foresight report. There are many unanswered questions about the introduction of a national programme, including any adverse affects, particularly on the child. The UK National Screening Committee (NSC), which makes recommendations to the government on screening programmes, has a policy on screening for childhood obesity (NSC, 2008). They have determined that there is not enough evidence of benefit to introduce a screening programme for obesity, at present, although they will keep the policy under review.

Population screening must be distinguished from opportunistic identification, where a vigilant health professional will assess an individual they consider at risk of a condition in a clinical context. It will usually rely on a multifactorial assessment, rather than the result of a single test or measure. Opportunistic identification of obesity, relying on health care practitioner clinical judgment, is recommended by the National Institute for Clinical Excellence.

In accordance with the programme level agreement with the Assembly Government, it was clear that the purpose of any national system would be for population surveillance, and not for population screening.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 35 of 89	

4.1.1 Effect on existing services

All NHS Trusts in Wales and Powys Local Health Board monitor the heights and weights of children. Methodologies differ, as do the staff undertaking the service and supporting the monitoring, including managers and administrative support staff. Data is collected and entered onto the Trust Child Health System then uploaded quarterly onto the National Community Child Health Database (NCCHD) by Health Solutions Wales. The introduction of any surveillance scheme would need to carefully consider any disruption to existing services, possibility of duplication of effort and any risks to existing services across Wales.

4.2 Legal considerations

The Health and Social Care Act, 2008, gives powers to Welsh Ministers, in Section 144, to provide for the weighing and measuring of junior pupils. It also gives Ministers further powers to make regulations including giving results of monitoring to parents.

4.3 Requirements of the study

Through the programme level agreement and discussion with Welsh Assembly officials it was clarified that the following were requirements of the study:

- Whole population coverage for a particular year or age group was required in a single area; a sampled approach was not considered acceptable. This is because a sampled approach could not give precision for an estimate of obesity on an annual basis at a local authority level in Wales.
- The study should cover the areas of four NHS Trusts who had volunteered themselves to the Assembly Government for participation. As it was considered that these were self selected and may not have been representative of nursing services across Wales in terms of resource, capacity or enthusiasm, the NPHS also approached Abertawe Bro Morgannwg University NHS Trust to participate. This Trust did not have a defined school nursing service, and so represented a Trust less immediately able to facilitate any future measurement programme.
- The study should be conducted amongst primary school aged children. This was because (1) the HBSC survey already gave estimates for obesity among older children (2) concerns were expressed about difficulty in ensuring legal consent among older children (3) as reception year / year one was a commonly accepted time for measurement, additional measures could be taken in the same school on the same day if those additional measures were primary school based.
- Parents should be explicitly given the option of requesting feedback of measures; this should include informing parents of their child's BMI as well as height and weight result.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 36 of 89	

- Welsh Assembly Government were keen to learn practical lessons from piloting of an actual programme, rather than a multiple work stream approach to assessing the feasibility of a national programme (see section 4.4.1).

4.4 Preparing for the pilot study

Although the aims of any future programme were clear on commencing planning for the study, the details of what such a programme would look like were not. Before piloting any approach these had to be considered.

In particular it was not clear:

- What ages of children should be included?
- Whether consent would be using an 'opt-in' or 'opt-out' system. Current practice is variable across Wales.
- Which staff should undertake measurements?
- How would data be collected?
- How would data be collated?
- Would it be reasonable to expect the NCCHD to be able to provide meaningful height and weight measures from the CCH2000 systems?
- What format should be used for giving the results of measurement to parents?
- How will giving results be undertaken?
- What support should be provided for parents on receiving results?

4.4.1 Workshop

A workshop was held in December 2007 involving interested agencies from across Wales to explore possible approaches to the feasibility study. This helped to identify an array of issues that would need to be considered in a future programme, and highlighted the complexity of measuring heights and weights for population monitoring (other than using a sample of children) in school age children.

A multiple work stream approach to assessing the feasibility of a national programme was initially proposed approach by the NPHS following the findings of the workshop; this included piloting measurements in only a small amount of children to explore issues involved before large scale measurements were commenced. However, through further discussions with the Welsh Assembly officials it was clear that piloting of a whole population coverage approach was required and that this should be undertaken in the specific Trust areas already identified.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 37 of 89	

4.4.2 Practice in other countries

Approaches to measuring height and weight vary across different jurisdictions. This is illustrated in Table 3.

Table 3. Guidance on children's height and weight measurement in selected countries

Country		Age of Measurement	Purpose					Comments
			Screening for overweight/obesity	Screening for low weight	Population monitoring	Screening for other health conditions	Other	
Wales, England, Scotland and Northern Ireland	National Screening Committee (NSC) Child Health Sub-Group Report (2004)	Weighed during infancy; at routine attendance as part of the child health programme Single height and weight measurement, around school entry	X	X	X	X	√	Considered good clinical practice, not as screening procedure NSC recommends childhood measurement of height and weight at around the time of school entry with 0.4 centile cut-off for height used to initiate referral. Weight measurement at the same time should form part of the public health core dataset.
	NSC policy - growth screening (2006)		X	X	X	√	X	
England	National Child Measurement Programme guidance for Primary care trusts (PCTs): 2008/2009 school year	Reception year: 4-5 year olds and year 6 (10-11 year olds)	?	X	√	X	√	Guidance for implementing measurement programme. Sending child's results to parents routinely regardless of their weight need.

Country		Age of Measurement	Purpose					Comments
			Screening for overweight/obesity	Screening for low weight	Population monitoring	Screening for other health conditions	Other	
	Measuring Childhood Obesity Guidance to PCTs-2006	As above	X	X	√	X	X	This guidance gives good guidance to PCTs on how to measure the height and weight of children. Contrast to NCMP guidance discouraged giving out BMI to children or parents; because there was lack of evidence to define benefits vs harm of doing so.
Scotland	Health for All Children Guidance on implementation in Scotland-2005	Primary school entry level	X	X	√	X	X	Guidance supports consistent implementation of the recommendations in the fourth UK report from the Royal College of Paediatrics and Child Health (RCPCH), Health for All Children (Hall 4), throughout Scotland. Helps to promote effective and integrated provision of universal and targeted services for children and families, not to monitor obesity or measuring children.
	Management of obesity in children and young people. A national clinical guidance-2003	NR*	X	X	X	X	√	Guidance is targeted for primary care health workers who care for child obesity and also those in secondary and tertiary cares to whom children with obesity may be referred to. Guidance recommends for management of obesity rather than measuring children to identifying obesity.
European Region	European Obesity Surveillance Initiative	Age 6-9 years	X	X	√	X	X	Sampled approach, in pilot phases

Country		Age of Measurement	Purpose					Comments
			Screening for overweight/obesity	Screening for low weight	Population monitoring	Screening for other health conditions	Other	
USA	DHFS, Wisconsin Nutrition and Physical Activity Programme-Guidance & Recommendations for schools- 2008	NR*	√	X	X	X	X	Guidance for schools for accurately weighing and measuring children. No age for measuring in school suggested.
	Michigan Quality Improvement Consortium Guideline-Prevention and Identification of Childhood Overweight -2008	Children 2yr or over are measured at each periodic health exam	√	X	X	X	X	For prevention and identification of childhood overweight by assessing BMI and analyse any risk factor for overweight. Importantly this guidance gives age specific information for prevention of overweight for preschool, school age and older people.
	Indiana state departments of health and education. Guidelines for Measuring Height and Weight: For Indiana school children K-12	Kindegarten to 12 grade (K-12) i.e., age 5 to 17 years	√	X	X	X	X	This guidance was developed to provide guidance to school personnel who will be collecting height and weight of students in their school environment. Data was collected and analyzed to screen children from year 5 to year 17 to determine the prevalence of overweight and obesity in Indiana children and the pattern of overweight over time. Does not clearly state whether the children to be measured every year or was it one off programme guidance.

* NR-Not Reported

Programmes with potential for direct comparison or participation

In England, a surveillance scheme was introduced in 2006 to monitor the heights and weights of children in reception year (4/5 year olds) and year 6 (10/11 year olds). It was introduced to support the Public Service Agreement target set in 2004 to halt the rise in obesity in children by 2010 in England. The measurement exercise is coordinated locally by Primary Care Trusts with the support of schools and the Department for Education and Skills. In the first year, just 48% of eligible children were monitored (Crowther et al, 2007). Measures were introduced to address the initial problems and uptake has subsequently improved to 82% for reception children and 77% for year 6 (Dinsdale, 2008).

In Istanbul in 2006, the European region of the World Health Organisation led the European Ministerial Conference on Counteracting Obesity, where the need was recognised for standardised and European-wide harmonised surveillance systems (WHO 2009). The WHO has published advice on the methodology to be adopted, using BMI (Caroli et al, 2007). It advises that the optimum age to monitor primary children is between 6 and 9, after the adiposity rebound and before the onset of puberty. Any surveillance at younger ages would be to establish prevalence to start preventative programmes. Any later age should include adolescents post puberty. The WHO European Childhood Obesity Surveillance System commenced in 2007/08 and will be repeated 2 yearly for primary aged children between 6 and 9 years of age.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 41 of 89	

4.5 The study steering group

A steering group was established to agree the protocol for the study, advise on its implementation and to provide expert input into developing the recommendations.

The Steering Group was established in January 2008, and met regularly (every two months) throughout the project. The final meeting to consider the Draft Report was held in May 2009.

The Steering Group was chaired by Dr Judith Greenacre, Regional Director of the National Public Health Service in Wales (NPHS) and comprised representation from Swansea University, NPHS, NHS Trusts, Welsh Assembly Government, Wales Centre for Health and the National Community Child Health Database. Full details of the Steering Group are contained in Appendix 1.

This group was essential to gaining agreement across multiple organisations and disciplines on what would be piloted.

4.6 Key agreed aspects of the programme to be piloted

Table 4. Key aspects of the programme to be piloted

Item	Conclusion	Rationale
Number of measures	Two	Gives greater depth of information and allows for follow-up of individuals over time (anonymously)
Younger age group for measurement	Reception year (4-5 years)	<ul style="list-style-type: none"> Common (but not universal) practice in Wales; Comparable to National Child Measurement Programme, England Height screening recommended at school entry by NSC
Older age group for measurement	Year 4 (8-9 years)	<ul style="list-style-type: none"> Comparable to European data; age group furthest from reception year that allows participation in European Surveillance almost all children still pre pubertal (puberty is a time of increased body image anxiety and greater variation in height weight relationships)
Approach to consent: opt in vs opt out	Requires evidence: this became a key "research question". Letters used are in Appendix 2	<ul style="list-style-type: none"> Opt in approaches involve more engagement of the individual with their own data; provide more certainty that individuals have consented to process and discussions with the Children's Commissioner's Office suggested a preference for this approach Opt out approaches are expected to lead to higher uptake of measurement and is current practice in many Trusts. There was no identifiable literature on effect of opt-in vs opt-out on uptake for simple measurements in school aged children If uptake were too low using an opt-in approach, then it would not be a feasible way to meet the objectives of the national programme. Any significant lack of response would be likely give

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 42 of 89	

Item	Conclusion	Rationale
		misleading results.
Organisation to undertake measurement	Existing school/community nursing services	Infrastructure exists for these organisations
Staff to undertake measures	Nursing staff overseeing support workers as required	Staff should be of sufficient training and skill to undertake height and weight measures for public health surveillance purposes.
Recording and collation of data	CCH2000/NCCHD	System in place to allow use of NCCHD <ul style="list-style-type: none"> Unique codes identified for the study not previously used, gave rise to real possibility of successful use of NCCHD Pseudonymised linkage possible to track individuals over time or with other data sources, keeping all identities remains anonymous
What format should be used for giving the results of measurement to parents?	A feedback letter was devised (Appendix 2)	<ul style="list-style-type: none"> Letter was based on findings of research by Teeside University for the Department of Health (Shucksmith et al, 2008) Letter provides brief explanation of BMI, and plots BMI centile showing BMI category: underweight, normal weight, overweight, very overweight.
How should giving results be undertaken?	Nursing service completes letter	<ul style="list-style-type: none"> Child Health Administrative Staff would not agree to results of data inputted being sent directly to parents; responsibility for completion of forms had to remain within nursing service for this study.
What sort of support should be provided to parents who receive results	As well as standard clinical contacts, NHS Direct Wales ran a dedicated support phone line & web page for parents.	<ul style="list-style-type: none"> Teeside University research (Shucksmith et al, 2008) suggested parents were unlikely to visit their GP or school nurse in response to receiving results A dedicated line would allow parents to follow-up results without having to involve their local clinicians A dedicated line could help keep a recorded of the numbers of contacts from families who wish further advice based on the results

4.7 Constraints

Taking part was voluntary for many organisations participating in this study and work had to be agreed through detailed negotiation. Contributing organisations included the NPHS, University of Swansea. five school/community nursing services from five different NHS Trusts, Health Solutions Wales, NHS Direct Wales.

A major constraint on the implementation of this study was the time available. This was particularly the case because:

- The Human Papillomavirus (HPV) vaccine was being introduced for the first time in schools during the same school year. Impacting on the resource of both nursing and child health administration; particularly on the early part of the academic year.
- Commencing the study was be delayed because:
 - agreement on the details of the potential future programme and what could be practically implemented in the pilot between the large number

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 43 of 89	

of agencies and professionals involved took some time. This included agreement on the factors above, and other matters, e.g. the content of letters that required considered and agreed wording.

- in order to learn the most from the study it was agreed to incorporate generalisable research methods. This required attaining NHS research ethics committee approval from a committee covering research in children.
- NHS Research & Development approval was required from the six participating NHS Trusts (the five pilot sites and Velindre NHS Trust) for the study to commence
- as a new process, agreement was obtained from each of the seven Local Education Authorities, and communications sent to all schools in the pilot areas advance of any approach to schools
- Unexpected delays in getting forms and letters translated and printed, with arrival of the forms coinciding with the commencement of school Christmas holidays.
- The final report had to be complete before the end of the academic year, at the end of May 2009. For this to be ready data had to be collected by the nursing staff, entered on local CCH2000 systems, downloaded onto the NCCHD, cleaned and analysed.

All of these factors substantially reduced the time available to collect, enter, clean, analyse, interpret and report information when compared to a normal academic year in an established programme.

4.8 Ethical approval

Ethical approval for this research was granted from the Leeds (East) Ethics Committee, November 2008. An agreement for minor changes to the study was agreed with the ethics committee to facilitate Swansea University undertaking qualitative aspects of the research study.

Approval was also obtained from the Research & Development Committees of the five pilot NHS Trusts and Velindre NHS Trust.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 44 of 89	

5 Aims and objectives

5.1 Aim

The aim was to undertake a feasibility study to inform a standardised national measurement programme of children's height and weight in Wales.

5.2 Objectives

The objectives of the study are:

1. To record childhood height, weight and related demographic data for children in identified pilot schools.
2. To compare the effect of different approaches to consent in terms of coverage; data quality and acceptability of the programme
3. To understand the views of children, parents and staff involved in the study regarding a national measurement programme.
4. To describe the costs involved and estimate the costs of introducing a national surveillance programme
5. To record, analyse, and communicate findings from the study, including publication in peer reviewed professional journals
6. To make recommendations to the Minister for Health and Social Services, including the implications of these, for an ongoing national measurement programme in Wales.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 45 of 89	

6 Methodology

This study involved the piloting of measuring of heights and weights in schools within specific geographic areas, and collecting and analysing data to assess the feasibility of such an approach as part of a national programme across Wales. This work was supported by an examination of published literature.

6.1 Measuring children's height and weight: the pilot

6.1.1 Participants

Two cohorts of primary aged children were selected for inclusion in piloting measurement of height and weight:

- reception – age four to five years
- year 4 – age eight to nine years

All state schools located within five geographical defined areas were included, except Swansea, where 60 of the 86 schools were included, as follows:

- Pembrokeshire (formerly covered by Pembrokeshire & Derwen NHS Trust, now a part of Hywel Dda NHS Trust)
- Flintshire and Wrexham (formerly covered by North East Wales NHS Trust now a part of North Wales NHS Trust)
- Powys (covered by Powys Teaching LHB)
- Merthyr Tydfil and the Cynon Valley (formerly covered by North Glamorgan NHS Trust, now a part of Cwm Taf NHS Trust)
- Swansea, part (formerly covered by Swansea NHS Trust, now a part of Abertawe Bro Morgannwg University NHS Trust)

These geographical areas cover a range of communities from all three NHS regions in Wales and include rural, urban and post-industrial valley communities.

We expected this population to cover 30% the relevant Wales population.

Children attending state schools (not necessarily residing) in these areas were selected for inclusion. Special needs and/or independent schools were included only where school or community nursing staff routinely visit and measure heights and weights. Children receiving home schooling were excluded from the study.

6.1.2 Height and weight measurement

The school or community nursing service undertook all measurements in schools. All staff were trained in the use and calibration of equipment and procedures to be

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 46 of 89	

followed. In some areas staff were employed specifically for undertaking measurements; in others existing part-time staff were contracted to work additional hours to undertake measurements. The grade of staff undertaking measurements varied. As a registered nurse was not required for undertaking the measurements, particularly for measurements not a part of existing programmes (year four or new reception year measures), in many instances they were undertaken by less senior staff (often Agenda for Change band 3) than those who traditionally undertake measuring in schools.

Height was measured using Leicester Height Measures. Weight was measured using WB100SMA Tanita weighing scales.

Children in reception year were measured by the school or community nursing staff in accordance current procedures for consent.

Children in year 4 were cluster randomised, by school, into one of two groups:

- group A – consent letters to parents offering the opportunity to *opt out* of the measurement for their children
- group B – consent letters to parents to *opt in* for the measurement of their children

Measures were taken in private. Children were asked to remove shoes and heavy outdoor clothing but normal indoor clothing was left on. Core data was recorded for each child as follows:

- Full name
- Date of birth
- Child code
- School name
- School code
- School address
- School postcode
- School year/class
- Age
- Gender
- Postcode of residence
- Date of measurements
- Height in centimetres to the nearest 0.5cm
- Weight in kilograms to the nearest 0.1kg

Ethnicity is a standard item on CCH2000 and was not sought from the school register.

BMI was not calculated at the time of measurements and individual results were not given to other children, the school or others at the time of measurement.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 47 of 89	

Where a child was not measured due to absence from school or a non-response from parents of children in Group B, a second attempt was made to measure the child by revisiting the school with or without re-sending the invitation letter, as appropriate.

6.2 Study design

Different study designs were used to undertake various aspects of the overall study

6.2.1 Quantitative interventional (experimental) study

A cluster, randomised, controlled design was used to examine the effect of opt-in *versus* opt-out forms of consent on the uptake of height and weight measures. It was applied in year 4 only. Obtaining consent for reception year pupils continued in accordance with the standard practice of individual Trusts.

Instead of allocating individuals to one group or another, as is undertaken in a randomised controlled trial, this study involved randomising groups (or clusters) of individuals. In this case schools, the cluster, or unit of randomisation, were randomly assigned to either group 'A', where families received an 'opt-in' letter; or group 'B' where families received an 'opt-out' letter. Randomisation was undertaken after first stratifying by the size of class, this was to avoid an imbalance occurring between the two groups as might happen if more larger schools were selected for one group. It is important that groups are randomised so that any difference observed between groups is likely to be due to the difference in the intervention and not other differences between the groups.

This approach was in line with recommendations for evaluating area wide interventions in health and healthcare (Ukomunne et al., 1999) It was considered that alternative randomisation by individuals would have caused chaos in the classrooms; randomising by NHS Trust would have given too much room for bias to influence any difference seen between those receiving 'opt-in' or 'opt-out' letters.

6.2.1. Quantitative observational study

This, like the interventional quantitative aspect of the study focussed largely on the collection of height and weight and related data.

Observational studies observe characteristics and do not involve any form of intervention or experimentation. The observational study is in order to describe the quality of the data collected to help understand how useful any information collected for a future study might be. It also allows early examination of initial findings on prevalence of underweight, normal weight, overweight and obesity in the pilot areas. This relates to objective 1 of the study.

6.2.1. Qualitative study

The qualitative study gathered the views of relevant people on the impact of the study, through interviews. It involved purposive samples of children, parents and staff

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 48 of 89	

directly involved in the study from all the geographical areas participating as well as GPs from one geographical area. It also involved prospectively collecting contacts or comments on the study raised by families or others during the study. It relates to objective 3 of the study.

6.2.2 Cost Assessment

Through a variety of techniques, estimates of costs involved in a National programme were developed. These are described in section 6.7, and in further detail in Appendix 3. This relates to objective 4 of the study.

6.3 Study Power

The power of a study relates to the ability to detect a difference between groups with confidence, that is, a difference that is unlikely to have occurred by chance. In order to detect a difference between an 80% uptake rate and a 75% uptake rate with 95% confidence at a power of 80%, using standard statistical tables (Lemeshow et al, 1990) it was calculated that 1,133 children would need to be randomly assigned to each group - a total of 2,266 children, with the school cluster approach slightly more children would be required. This was expected to be achievable given the size of population in the study areas.

6.4 Height, weight and related data

Collection of height and weight data is described in section 6.1.2.

6.4.1 Additional data collection as part of height and weight measuring process

At the end of each school visit the following information was collected:

- Visit workload form – completed by community or school nursing service undertaking the visit. It included distance travelled, time travelled, school visit number, time spent on the measurement programme. This has contributed to the costing assessment.
- School return form – completed by school staff. It included details of the number of boys and girls in each class, absentee numbers, parents or children declining examination or consent, physical education lessons, indoor and outdoor play areas and food types available on the premises. This form was designed by the World Health Organisation European Childhood Obesity Surveillance Initiative and would support the data collected from this feasibility study contributing to the European study for year 4 children.
- Data collection form: school experience of session – to be completed at the end of the day by a member of school staff. This included the level of

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 49 of 89	

disruption to staff and educational activities and concerns or issues raised during the day (see section 7.5).

Contact from parents / families in relation to the programme were completed by community or school nursing service to record any feedback or comments from parents/families relating to the implementation of the programme.

6.4.2 Height and weight data processing

Data from the study was entered, by NHS Trust or LHB (Powys) staff, as appropriate, onto the Trust Child Health Systems (CCH2000) and uploaded onto the National Community Child Health Database. The routine quarterly update was updated to accommodate the additional information gathered. Health Solutions Wales provided a relevant extract of the data to the NPHS Health Information and Analysis Team for analysis.

The study used pre-existing height and weight codes (exam 70 and 71) which were previously not in use by Trusts across Wales.

Health Solutions Wales provided an extract of data where the examination code is either 70 (reception year) or 71 (year 4) and the age range of the children was between 1 September 2003 and 31 August 2004 (reception year) or 1 September 1999 and 31 August 2000 (year 4). According to the study's data collection protocol, these examination codes are attached to the child record whether or not the child is eventually measured. Therefore the denominator for the study is all children born within the above age ranges with an attached examination code of 70 or 71.

6.4.3 Height and weight data analysis

Data Quality

Analysis of data was undertaken to assess the quality of the data, to ensure it was robust enough to provide valid results.

Uptake of Measurement

Analysis of uptake was undertaken to assess participation in the study. This was necessary to have as a worthwhile national measurement programme must ensure high levels of uptake. Low uptake rates would mean that data may not be representative and therefore the programme would be of little benefit in terms of the core aims of the study.

Uptake rates were calculated both using National Community Child Health System derived data, and data derived from the European forms.

Uptake rates were analysed according to:

- Trust
- Age, including a breakdown according to parental consent method for Yr 4 pupils (A – opt-out; B – opt-in)

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 50 of 89	

- Sex
- Deprivation 5th (WIMD 2008) for NCCHD data

Results of Measurement

Body mass index (BMI) was calculated for those children for whom a valid height and weight measurement has been recorded and was categorised as either:

- underweight;
- normal weight;
- overweight (not obese); or
- obese

based on the International Obesity Task Force (IOTF) cut-off points for overweight and obesity and thinness cut-offs recommended by Cole et al.

Data were analysed by sex, year group and parental consent method.

Analysis of the proportion of children overweight or obese was undertaken at local authority level, as this is an expected requirement of any future programme. However, inclusion in the feasibility study is based on the location of the school and not the residence of the pupil. For this reason, local authority in which the school is situated was used rather than the local authority of residence of the children.

A breakdown of the proportion of children overweight or obese was provided by fifth of deprivation. This was done based on the Welsh Index of Multiple Deprivation (2008) which is provided at lower super output area (LSOA) level.

Weight measures were not adjusted for the clothing worn and statistical testing for this report did not take account of the possible influence of clustering.

6.5 Interviews with children, parents and staff

This work was undertaken to help understand the views of children, parents and staff involved in the study regarding a national measurement programme (objective three). The full report of the qualitative study is contained in Appendix 4.

6.5.1 Selection of subjects for interview

Parents

The goal was to engage two families in each of the five pilot areas, one family being from a school in a deprived area and one from a school not in a deprived area. Half of the families contacted had children attending small schools and half had children attending large schools. Within Powys, the aim was to include one family with a child attending a Welsh-medium school. The assumption was made that only 25% of the families contacted would agree to take part so that four times the required number of families were contacted. 64 parents were contacted with the aim of 16 responding.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 51 of 89	

Children

A purposive sample was used. This was selected to be representative of area, whether or not parental feedback had been requested and age (both reception and year 4). Using this approach 64 parent's of children were contacted, anticipating that 16 children would be interviewed for the evaluation.

Staff

A range of staff roles were invited for interview for inclusion in the study, representing all five geographical areas. 15 staff members including managers and junior roles in nursing and administration were invited. Interviews were carried out in two locations in the North and South of Wales.

6.5.2 The interview process

Parents and staff

Parent and staff interviews were carried out according to agreed schedules. Interviews were carried out in the parents' homes. All interviews were recorded and transcribed verbatim.

Children

Since the interviews with children formed a particularly important and sensitive element of the study, the methods employed for this are included in some detail. The methods were formulated by the research team of Swansea University's Centre for Child Research. The following is the relevant extract from their report.

Engaging children with developmentally appropriate methodologies

Play is children's natural mode of action. During play, children feel happy, in control and free from any fear of failure (Howard, 2002). Research also demonstrates that children show more active and prolonged engagement in playful rather than formal activities (McInnes, Howard, Miles and Crowley, 2009). For these reasons it was felt that a playful methodology would be the most appropriate participatory technique to engage children in the research process. Regard was had of the ages of the children in the development of methods and the need to ensure that authentic responses were documented. A series of methods that ensured the children felt at ease with the research process were used. This allowed the children, as participants in the research process, to fully engage in a playful context. The project aims were met by framing discussions within structured play activities and the use of appropriate and accessible language. Specifically these play activities included the use of a weighing and measuring activity, a hideaway puppet and a feelings storybook. A brief rationale and description of each is provided below. Figure 3 shows the complete set of materials used in the procedure.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 52 of 89	



Figure 3. Materials used when talking with the children

Weighing and measuring - as an introductory activity, this was selected as a task that would be familiar to the children but also likely to facilitate development of a discussion that focused on being weighed and measured. The children were offered the opportunity to weigh and measure different small items from a 'treasure bag' using a balance scale. The use of the same equipment in the feasibility study was deliberately avoided to prevent any negative emotion associated with the weighing and measuring experience that might be unnecessarily evoked. The weighing and measuring game (Figure 4), led to the researcher asking about when the children were weighed and measured in school. To ensure children were talking about the NPHS weighing and measuring activity, photographs of the equipment used by the NPHS team were used (Figure 5).



Figure 4. The weighing and measuring game

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 53 of 89	



Figure 5. Photographic prompt of the scale used in the weighing and measuring pilot

The hideaway puppet - the hideaway range are high quality, plush characters that are frequently used in therapeutic work with children as they lend themselves well to conversations about feelings. They are simple to operate and attractive to children.

The 'All Kinds of Feelings Book' (Emma Brownjohn) - one of a series, designed to support children's personal and social development and this one in particular facilitates discussion with children about their own and other people's feelings. It is highly interactive with flaps to lift, attractive illustrations, games and activities.

Ensuring an accurate representation of children's thoughts and feelings

Children are capable of sharing their life experiences; however, as proposed by Einarsdottir (2007), it is the responsibility of the researcher to ensure that the procedures that are adopted to facilitate their active participation in the research lead to the collection of data that accurately represents their views. The issues that were relevant to this research were to ensure that the children were talking about this particular weighing and measuring experience and that they were able to comprehend and explain emotional states.

Considering these issues maximised the potential to achieve an authentic response and subsequent validity of findings. Research demonstrates that children in playful situations demonstrate higher levels of meta-cognition than children operating in a formal setting (Whitebread et al., 2005). In play, it appears that children are better able to articulate their thought processes. Therefore, to achieve authentic response, simple verification techniques were built into the project design, again utilising play activities to guide discussion.

To ensure children could recognise and explain emotional state, the researchers asked "what and why" questions whilst the child was playing with the hideaway puppet (see Figure 6). If the researcher felt that a child's understanding of emotional state remained ambiguous after the puppet activity, the feelings storybook was introduced. The child and the researcher read the book and played a 'draw a face' game. This involved the child spinning a dial and then drawing the face they felt depicted the emotion they had landed on (see Figure 7).

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 54 of 89	



Figure 6. Playing with the hideaway rabbit puppet



Figure 7 The book was used to clarify the child's understanding of feelings

Ensuring ethical conduct

The research was conducted by experienced research staff from the Centre for Child Research (CCR), Swansea University. All of the team had full police clearance for working with children and vulnerable groups. In addition to the consent from parents obtained via the NPHS, the research team also ensured each child's verbal consent to participate in the interview by means of a standardised statement at the start of the process. Researchers also asked the children's permission to record the interview using the dictaphone.

All children were interviewed on a one-to-one basis in a quiet area in their school and for child protection reasons the teacher was either present or proximal.

Procedure

Each interview lasted 20-30 minutes, and, following each child's consent, was recorded using a digital recorder. Each researcher followed a script to structure the interview process. The play activities within the interview script facilitated movement through a series of questions that related directly to the project aims.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 55 of 89	

6.5.3 Analytical methods

Interviews with parents and interviews with staff

The data were analysed thematically. A coding frame was devised based on the schedule for the interviews with parents, covering the following themes:

- understanding the purpose of the study;
- consent;
- motivation for agreeing to take part;
- results of measurement;
- suggestions for the future development of the programme.

The coding framework for staff covered the following themes:

- understanding the purpose of the study;
- consent;
- results of measurement;
- suggestions for the future development of the programme.

Two researchers analysed the transcripts, selecting instances of talk relating to each of the themes. An additional theme – obesity and the stigma associated with it – emerged during the analysis of the interviews with parents. The two researchers discussed, revised and agreed the findings.

Interviews with children

The data were analysed thematically following the systematic guidelines of Braun and Clarke. The first level of analysis involved identifying instances of talk that referred to each project aim. These responses were then grouped thematically. Following this, the data were then revisited to identify instances of talk that were relevant, but not accounted for in stage one. For reliability, two researchers analysed the data following the same systematic procedure. On the single occasion where an instance of talk was coded differently by each researcher, a third researcher read through the transcription of this particular session to clarify the meaning of the statement.

6.6 Providing BMI results to parents, and its impact

Three pilot sites explicitly offered parents the opportunity to receive results of their height and weight measures. These were Pembrokeshire, Flintshire and Wrexham, and Merthyr and the Cynon Valley.

The format in which parents were offered the option of receiving feedback and the format of letters returned with feedback are shown in Appendix 2. Letters were filled

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 56 of 89	

in manually by staff of the nursing service as described in Table 4. This required calculating the BMI using a standard BMI calculator, plotting this on a centile chart and then marking the centile position on the letter supplied. Underweight, normal weight, overweight or obese were classified in accordance using the UK 1990 cut-offs of 2nd, 91st, and 98th centile cut offs as is normal in clinical practice when interpreting the BMI of an individual child (see section 3.2).

To support any concerns parents may have a dedicated help line was set up and run by NHS Direct Wales, and an accompanying website. Through this parents could access:

- A leaflet on managing their child's height and weight, including a list of national resources
- The Change4Life / Health Challenge Wales packs for healthy diet and exercise
- A list of local resources to support healthy eating exercise and children's weight related programmes

Parents were also reminded that if they had concerns they could contact a health professional such as the school nursing service or GP. GPs had been contacted with information about the study; a list of local resources to support concerns over childhood obesity was made available on the NPHS intranet site.

In addition to views of parents, children and staff in relation to feedback received, the study assessed contact parents had with health services on receiving the results of their children's BMI, and the impact of parents receiving feedback on those services.

6.6.1 General Practitioner Survey

It was anticipated that some parents may contact their child's GP to discuss any concerns they had about their child's height or weight following the study and this increase in workload needed to be captured.

In order to estimate the impact of the study on the workload of GP practices, a follow-up questionnaire was sent to all of the GP practices in Pembrokeshire. Pembrokeshire was selected as it was the first area to complete all measurements and provide feedback to parents. The questionnaire requested information on whether the GP practitioners were aware of the study and information on whether they had been contacted to discuss any of the children's' results, and if they had any comments or suggestions.

6.6.2 NHS Direct Wales

A record was kept of the number of contacts with the dedicated NHS Direct Wales helpline and hits on the website. No personally identifiable information was collected.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 57 of 89	

6.6.3 Contact with nursing staff

Nursing services prospectively maintained a record of contacts with their service including any contacts for support or advice (see section 6.4.1). This form did not include personal information relating to individuals.

6.7 Cost assessment

The purpose of this element of the study was to estimate the financial cost of implementing the feasibility study measuring childhood heights and weights in the pilot areas in Wales and to estimate the costs of implementing an All-Wales programme of measuring childhood heights and weights. Costs of the research elements of the study were excluded.

For each school a school return form was completed by school staff in advance of the visit by the school or community nurse. On completion of each visit to a school a workload form was completed by the staff undertaking the visit. The workload form was entered onto an access database by staff at Swansea University and the data was analysed. The measurement information was entered into the child health database and data extracted, cleaned and analysed. The regional co-ordinators completed a questionnaire at the end of the study providing information on workload for the regional co-ordinators, time spent by staff managing the school visits and data entry.

Data from the individual pilot areas was collated and the preliminary costs were presented to the members of the steering group to ensure that the estimates were reasonable. An estimate of costs for undertaking the study per 1,000 children measured at a local level, and additional national costs have been described.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 58 of 89	

6.8 Literature review

A literature review was undertaken to inform and support the study. These were designed to search English language published literature to answer the following four questions. Full details of the search methodology are included in Appendix 5. The literature search addressed the following questions:

- Is BMI a reliable measure of obesity in children?

This question was to help understand the limitations of BMI in measuring population levels of childhood obesity.

- What is the effect of puberty on BMI?

This question was used to assist in considering a second age for population monitoring. Insufficient literature was identified to support the original question: 'what is the best age for weighing and measuring children for population monitoring purposes'.

- What are parents and children's attitudes to childhood height and weight measuring programmes?

This question helps inform the acceptability of any possible measurement programme.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 59 of 89	

7 Results

14,100 children were measured in 457 schools in the pilot study. The schools included at least one independent school and eleven special needs schools. All schools agreed to participate. One school refused measures in reception year only, as they were introduced using an 'opt-out' approach throughout the area (Pembrokeshire) and the school was not happy to use this approach².

7.1 Results of measurement of children's heights and weights

The NCCHD dataset included the anonymised details of 16,315 children who were born within the above age ranges with an attached examination code of 70 or 71. However, this is an underestimate as in one area not all data were captured (see section 7.1.1).

7.1.1 Data quality

Having analysed the data it became clear that some were missing in the extract taken from the North Wales CCH2000. Further investigation showed that the system allows 'withdrawn consent' to be recorded in a way which had not been anticipated prior to undertaking the study. In these cases the examination code was not generated and, hence, data were not uploaded onto the NCCHD. For this reason, data for the Flintshire and Wrexham area are excluded from this section and from the uptake of measurement section.

Steps were taken to ascertain whether this problem had manifested itself in other areas. Colleagues at Health Solutions Wales were able to provide figures relating to the total number of children in each area within the relevant school years. This shows whilst in Flintshire & Wrexham data appear to be missing for around a quarter of pupils, in the remaining areas the percentage of children captured is much higher: 88% in Powys; 95% in Merthyr and the Cynon Valley and 97% in Pembrokeshire. Data for Swansea are excluded since only part of the area was included in the feasibility study.

Table 5 shows the percentage of records which were complete with valid data stratified by study area. The table shows that most fields exhibited a very high level of complete and valid data. The main exception was the ethnicity field. This information was not specifically collected as part of the study but forms part of the NCCHD minimum data set. It was hoped that an analysis of height and weight could be carried out stratified by ethnic group but the data below demonstrate that this will not

² The year four group in this school had been randomised to 'opt-in' and so year 4 measures were taken in the school.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 60 of 89	

be possible. The ethnicity field is normally populated at birth. The figures are especially low for Swansea and this is because, in the past, ethnicity at birth was not recorded. It is our understanding that completeness of ethnicity recording at birth is now much improved in this area. The table also shows that, in the case of Swansea, the height and weight consent fields were only around 60% complete and valid. What the table does not show is that whilst the other trusts achieved very high levels of valid and complete data for the consent fields, the vast majority were left set at the default 'consent given' setting. This meant that it was not possible to use these fields to analyse uptake as had originally been intended.

Table 5. Percentage of records complete and within a valid range by pilot site

	School code	LSOA	DOB	sex	Ethnicity	Nurse consent	Height consent	Weight consent	Exam date
Merthyr Tydfil & Cynon Valley	99.8	99.2	100	100	47.9	99.6	99.6	99.6	99.2
Pembrokeshire	99.8	99.4	100	100	39.3	99.3	99.7	99.7	100.0
Powys	99.7	98.9	100	100	44.1	99.4	99.0	99.0	99.8
Swansea (part)	99.7	99.9	100	100	0.7	99.1	60.9	60.9	100.0
All [†]	99.7	99.4	100	100	29.7	99.4	86.8	86.8	99.8

[†] Excluding Flintshire & Wrexham;

Table 6 shows the number of records with a valid BMI by pilot site. The distribution of the data was analysed and on that basis, and taking account of advice of experts on the study steering group, valid BMIs were considered to be those lying in the range 10 to less than 35. The table shows that, of those children who had height and weight recorded, the vast majority (over 99%) were within a valid range, or, put another way, plausible.

Table 6. Records with a BMI within the valid range* by pilot site

	BMI within range	BMI outside range
	Number (%)	Number (%)
Merthyr Tydfil & Cynon Valley	2314 (99.40)	14
Pembrokeshire	2079 (100.00)	0
Powys	2050 (100.00)	0
Swansea (part)	2866 (99.97)	1
All [†]	9309 (99.84)	15

*valid range: BMI ≥ 10 and < 35

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 61 of 89	

† Excluding Flintshire & Wrexham

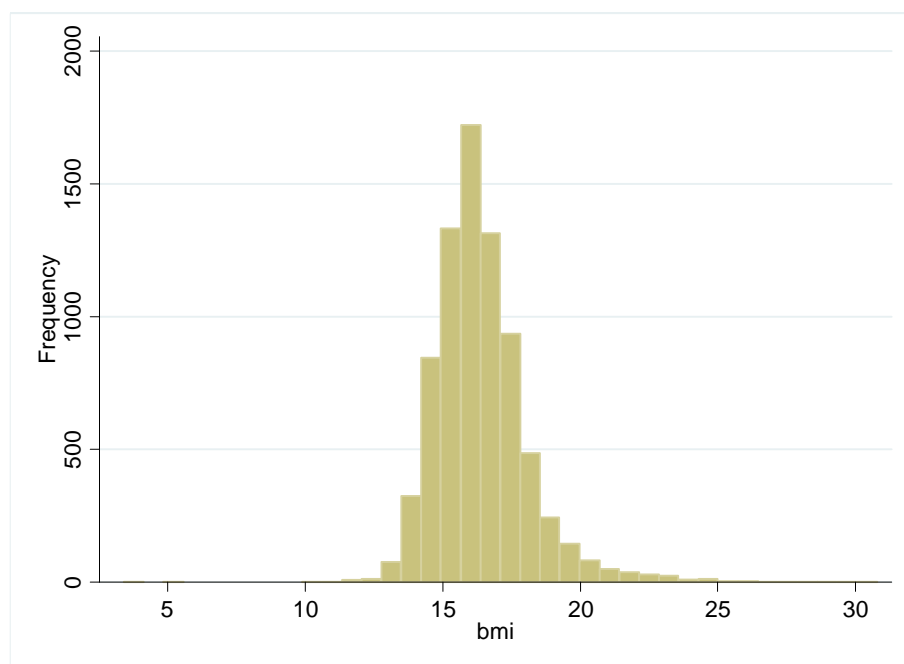


Figure 8. Distribution of BMI results (BMI < 50), reception year

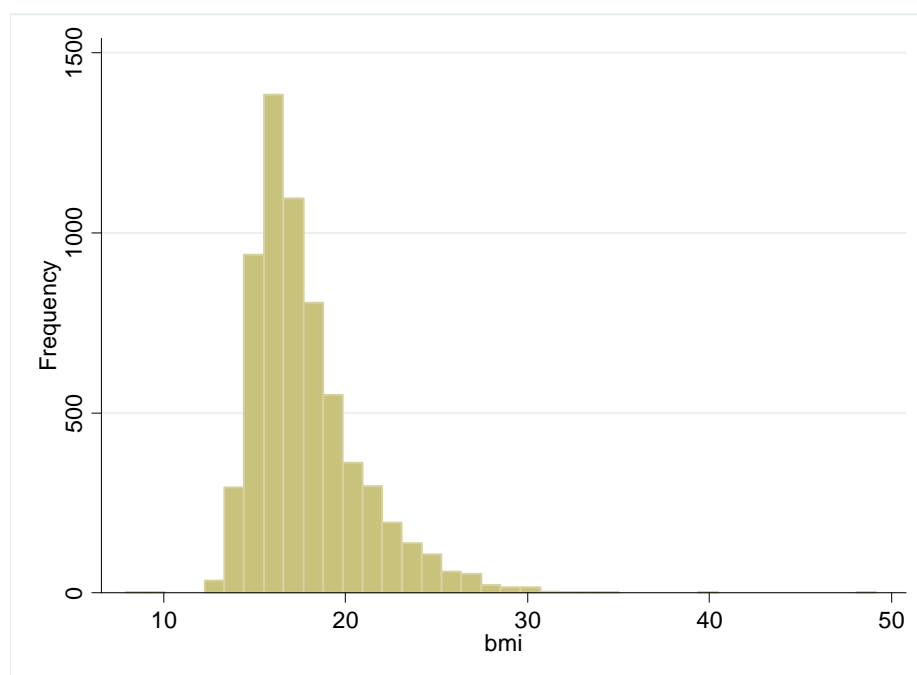


Figure 9. Distribution of BMI results (BMI < 50), year 4

Figure 8 and Figure 9 are histograms showing the distribution of BMI values. The figures indicate the high quality of the data signalled by the fact that there are very few implausible outliers. The distributions are as would be expected with the weight data and

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 62 of 89	

BMI data being positively skewed whilst the height data are normally distributed. Further histograms for height and weight are included in appendix 6.

7.1.2 Uptake

For full results on uptake, including analysis by deprivation fifths, see appendix 6.

In addition to having data which are of a consistently high standard in terms of their quality, a worthwhile national measurement programme must ensure high levels of uptake. Low uptake rates would mean that data may not be representative and would undermine the core programme aims of:

- monitoring trends;
- assessment of population based interventions;
- acting as a source for population based epidemiological research.

Estimating uptake accurately has proved problematic because:

- consent data was not recorded correctly on the data system (see section 7.1.1) so this could not be used to examine uptake
- the denominator provided by the NCCHD was incomplete, as some of those who were not measured were not on the extract provided due to technical difficulties (see section 7.1.1). For this reason:
 - Flintshire and Wrexham are excluded from these analysis
 - A 'check' analysis was undertaken using initial analysis of the European Mandatory School Return form data. European forms also have their problems, as not all schools have a form returned (see section 7.2).

Analyses (Table 7, Table 8) demonstrate that where programmes are long running or at the start of school (reception year) uptake is higher than in a year 4 programme.

Within year 4, uptake is substantially higher among those receiving the opt-out approach to measurement as compared with the opt in approach (87% compared with 60% using the NCCHD; 88% compared with 54% using European forms).

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 63 of 89	

Table 7. Percentage of children* where a height or weight measurement was recorded by school year and trust, NCCHD

	Reception	Year 4 opt-out	Year 4 opt-in	P value**
Merthyr Tydfil & Cynon Valley	96.4	93.7	78.2	<0.001
Pembrokeshire	94.5	90.6	62.2	<0.001
Powys	86.2	83.8	58.1	<0.001
Swansea (part)	90.6	81.8	46.3	<0.001
All	91.7	86.9	59.4	<0.001

** Excludes 13 children where the year or opt-in/opt-out group could not be established

** P value does not take account of cluster effects; this may be an overstatement of the statistical significance.

Table 8. Percentage of records where a height or weight measurement was recorded by trust, reception year children, European forms

	Reception	Year 4 opt-out	Year 4 opt-in
Flintshire & Wrexham	86.2	85.1	52.2
Merthyr Tydfil & Cynon Valley	87.8	87.6	69.8
Pembrokeshire	90.0	89.1	50.7
Powys	88.2	89.6	55.8
Swansea (part)	84.6	89.0	48.5
All	86.8	87.5	53.9

7.1.3 BMI results

BMI category by year group, gender and consent method

Table 9 to Table 11 summarise the BMI status of all children, boys and girls measured in the study respectively according to IOTF overweight and obesity cut-offs and thinness cut-offs.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 64 of 89	

Table 9. Percent underweight, normal weight and obese by age group, all children.

School year	Underweight	Normal weight	Overweight, not obese	Obese
Reception	0.9	76.8	16.6	5.6
Year 4 opt-out	0.3	71.2	19.5	9.1
Year 4 opt-in	0.4	73.2	18.9	7.5

Table 10. Percent underweight, normal weight and obese by age group, boys.

School year	Underweight	Normal weight	Overweight, not obese	Obese
Reception	1.1	79.4	15.0	4.5
Year 4 opt-out	0.2	74.3	17.5	8.0
Year 4 opt-in	0.3	76.2	16.3	7.1

Table 11. Percent underweight, normal weight and obese by age group, girls.

School year	Underweight	Normal weight	Overweight, not obese	Obese
Reception	0.8	74.1	18.3	6.8
Year 4 opt-out	0.4	67.8	21.6	10.2
Year 4 opt-in	0.5	70.2	21.4	7.8

Very few children (less than 100) were classified as underweight. The proportion of children who were overweight or obese was higher in year 4 compared with reception year. In addition, the tables show that in both year groups girls were more likely to be overweight or obese than boys. It is interesting to note that, compared with the year 4 opt-out group, in the year 4 opt-in group the proportion of girls categorised as obese was only slightly higher than in boys. This may indicate that an opt-in consent method maybe less likely to capture the full extent of obesity among girls in this age group.

BMI category by local authority area

In reception year children, the percentage who were overweight or obese (adult BMI equivalent of 25+) did not vary greatly between local authority areas, ranging from 21 to 24%. In year 4 the percentage overweight or obese was higher and there was

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 65 of 89	

more variation between areas. This greater variation is due to year 4 children in the Merthyr Tydfil and Cynon Valley areas exhibiting a much higher percentage who are overweight or obese. In the year 4 opt-out group, over 40% of girls in the Merthyr Tydfil area were overweight or obese.

On average, the parental opt-out group had a slightly higher overweight or obesity rate than the parental opt-in group, although the difference was not statistically significant ($p = 0.061$). This pattern was seen in most local authority areas; girls in Powys and boys in Pembrokeshire are notable exceptions. The overall pattern could indicate that parents of overweight or obese children may be less likely to indicate a willingness for their children to be measured using an 'opt-in' method.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 66 of 89	

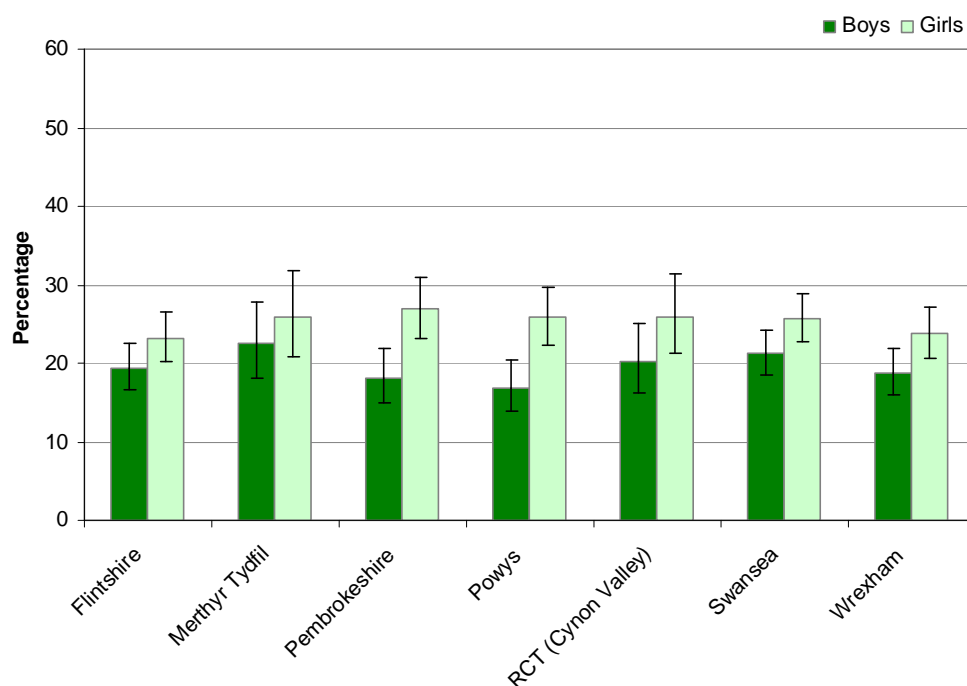


Figure 10. Percent overweight or obese* by local authority, reception year**

* IOTF cut-offs; ** based on local authority of school

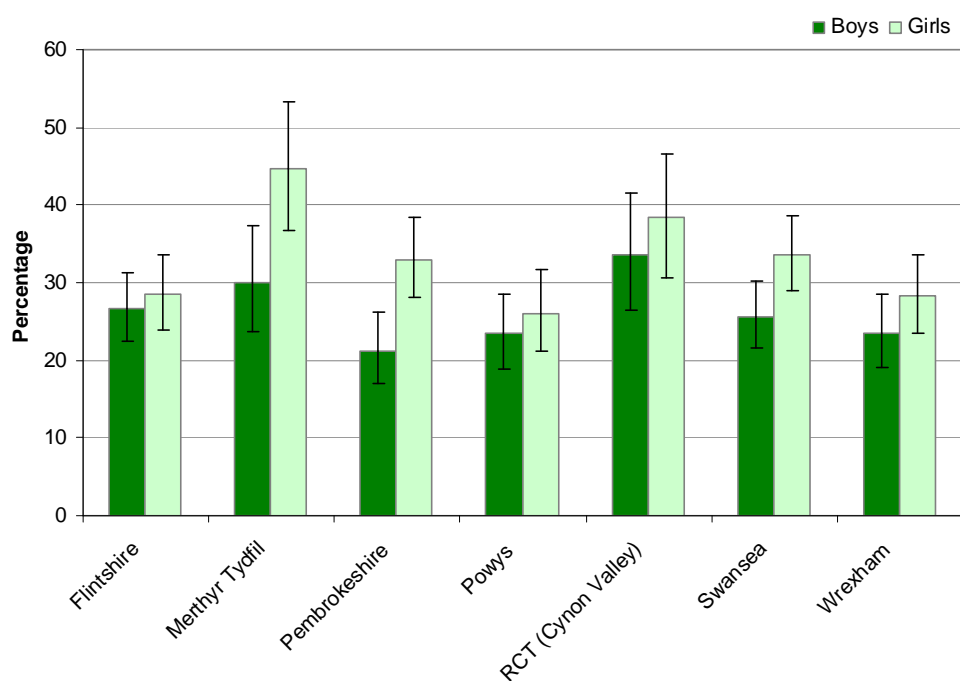


Figure 11. Percentage overweight or obese* by local authority, year 4 opt-out**

* IOTF cut-offs; ** based on local authority of school

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 67 of 89	

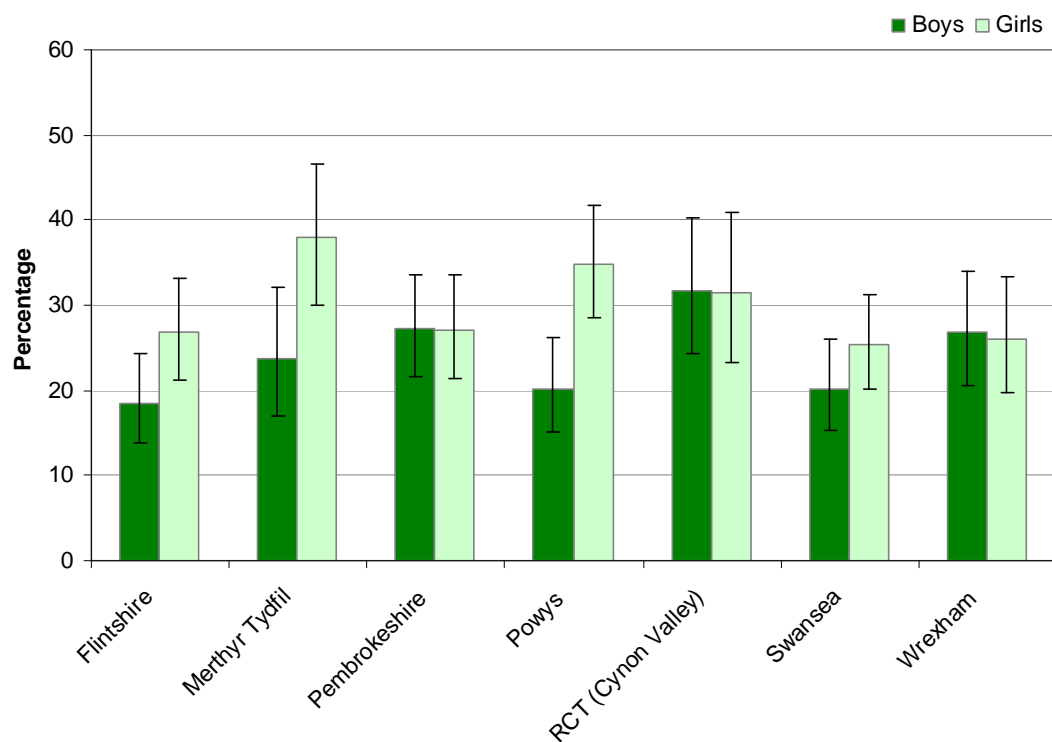


Figure 12 Percent overweight or obese* by local authority, year 4 opt-in**

* IOTF cut-offs; ** based on local authority of school

BMI category by deprivation fifths

Across all groups, children resident in the most deprived 5th of LSOAs had higher overweight and obesity rates than their counterparts resident in the least deprived fifth of LSOAs (Table 12). The statistic used to demonstrate this is the 5:1 rate ratio whereby the rate in the most deprived fifth is divided by the rate in the least deprived fifth. A 95% confidence interval was then calculated around each of the rate ratios. These rate ratios are all higher than one, indicating higher rates in the least deprived group and, since the lower confidence limits are all higher than one, this shows that the differences are statistically significant. The data show that the deprivation gradient is steeper in year 4 children than in reception year and that the gradient is steepest in the year 4 opt-in group. These gradients are illustrated in Figure 13 and Figure 14.

Table 12. Percentage of children overweight or obese* WIMD fifth of deprivation and school year**

WIMD = Welsh Index of Multiple Deprivation. * IOTF thresholds. ** excludes children where ht/wt not recorded, BMI outside range, or BMI or cat null, no group or no year, or LSOA outside Wales or LSOA not recorded.

WIMD fifth	Reception year			Year 4 opt-out			Year 4 opt-in		
	%	LCL	UCL	%	LCL	UCL	%	LCL	UCL
1 (Least deprived)	20.4	18.1	22.8	25.8	22.2	29.7	20.0	16.5	24.1
2	19.6	17.9	21.5	27.7	24.9	30.7	26.8	23.5	30.4
3	24.0	21.9	26.2	26.8	23.8	30.0	27.7	24.1	31.7
4	23.2	21.0	25.6	28.3	24.9	31.9	29.3	24.9	34.2
5 (Most deprived)	23.9	22.0	25.9	32.4	29.6	35.4	27.8	24.0	32.0
Wales	22.2	21.3	23.2	28.5	27.1	30.0	26.4	26.4	28.2
Rate ratio 5:1	1.17	1.02	1.35	1.26	1.06	1.49	1.39	1.09	1.76

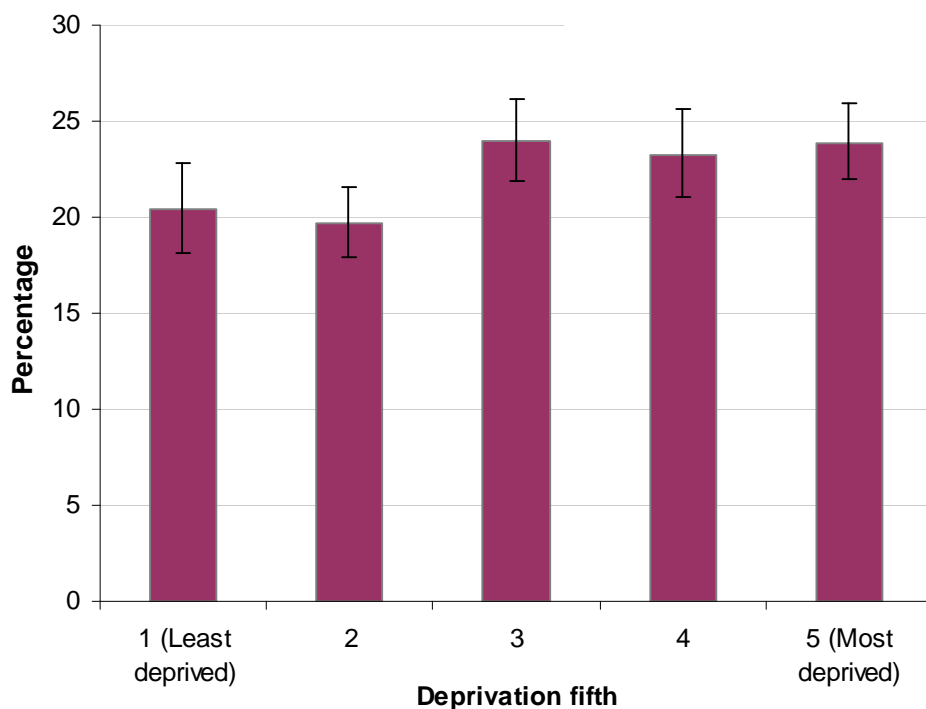


Figure 13. Percentage of children overweight or obese by WIMD fifth of deprivation, reception year

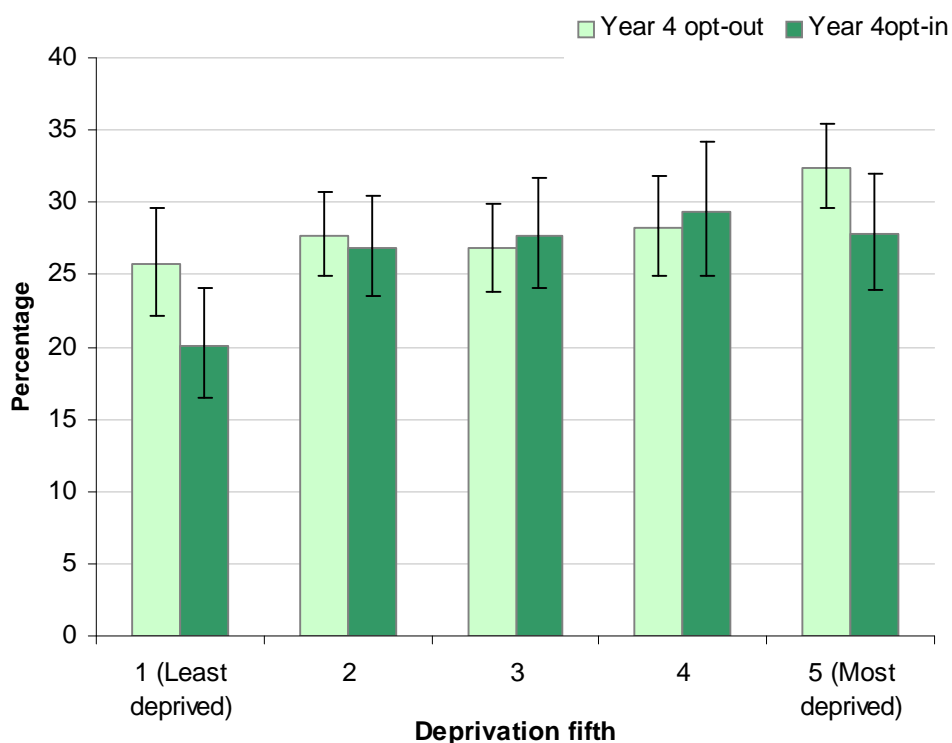


Figure 14. Percentage of children overweight or obese by WIMD fifth of deprivation, year 4

7.2 European surveillance

Measurements taken for this study in year 4 are contributing to the pilot of the World Health Organisation European Childhood Obesity Surveillance Initiative (COSI). This initiative involves measuring children of a specific age group between 6 and 9 years of age every two years (the next round of measurement is 2009/10). The findings of the pilot across 13 European countries will influence the final protocol to be agreed for future data collection.

Due to limitations of the CCH2000 system, and as agreed with the WHO offices, some mandatory data items could not be collected as part of this pilot. These include time of measurement, type of clothing worn and reason a child refuses measurement.

A mandatory school form was included as part of data collection. Of the 457 schools included, initial analysis suggests forms have only been returned for 390 (85%), and a number of anomalies have been identified in the data entered. Whereas the work was undertaken under greater time constraints than would be expected in a normal programme, it highlights the need for tight quality control procedures to ensure such data is collected completely and accurately.

Full analysis of these forms has not been undertaken for this report but data will be cleaned and made available as part of participation in the European project.

7.3 Interviews with children, parents and staff

Semi-structured interviews were conducted with parents, staff and children who were involved in the project as part of the feasibility study measuring childhood heights and weights in Wales.

These interviews were carried out by researchers over two weeks in May 2009, at varying times after the measurement of children had taken place. All parents interviewed were parents of children who had been measured. The staff interviewed were of varying grades and had a variety of roles within the measuring programme and all children had participated in the programme.

There were 10 interviews of parents (8 mothers interviewed alone, one father interviewed alone and one couple interviewed together). There were 12 interviews of staff and 10 with children (one in the reception year and 9 in year 4).

All interviews were recorded, transcribed and analysed according to standard qualitative research methods.

7.3.1 Main results – parents and staff

- There was ambiguity in parents' comments about their understanding of the purpose of the measurements in that, although most were clear that the purpose was population monitoring or surveillance, these same people also

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 71 of 89	

regarded the results as of at least potential value with regard to the health of the individual child.

- This ambiguity was also present amongst staff, in an awareness that you cannot separate out the identification of problems in individual children (which they are used to doing and which have implications for follow-up) from a population study.
- All the parents who took part in the interviews had consented to their children being measured, though when asked they were not always entirely clear that this had happened. However, in general, parents did not seem to consider the issue of consent as problematical. There was a sense from many that measuring a child was a routine part of what happened at school, and one which they were quite familiar with already. Many gave considered responses to this question, discussing issues such as differences in response rates according to opt-in and opt-out models
- Staff were more concerned with issues related to consent. There were mixed view points including anxieties about the risks associated with opt-out; concerns that the opt-in approach might generate bad feeling in parents, for example, follow up letters were sent if people didn't respond within a certain time.
- In terms of suggestions for future programmes: some parents were interested in what use the Assembly was intending to make of the results and feedback would have been appreciated to see where their children fitted into "the national average."
- Staff had enjoyed being involved though many reported that the programme was more work than anticipated. Providing feedback was particularly time-consuming and the process was too rushed. Senior staff had less time to spend on their core duties.
- Children rarely told their parents that the measuring sessions had taken place. Parents regarded this as a good sign – that their children had not been troubled by the experience. However, staff commented that children had often been engaged and interested in the measuring (and had sometimes, on their own accord, declined to be measured) and emphasised the role of the child in the process.
- Parents who requested their child's results were in general satisfied with the format in which they received these results. Some felt they would have attended their GP if the results had not been a normal weight.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 72 of 89	

- A number of suggestions for modification of the programme were made by staff. A request made by some parents was for knowledge of what use was being made of the population level results.

7.3.2 Main results – children

- All of the children remembered being weighed and measured and most (though not all) knew that this was going to happen. None of the children knew why they were being measured although they did offer suggestions.
- There appeared potential for children to worry about what might happen to them as a result of their measurements.
- The way in which the children had received information about their participation was inconsistent. It seems that even if the children were given information about the initiative they had not understood it fully or been given the opportunity to provide informed consent. The children knew very little about the staff who were taking the measurements.
- The children were unclear about the information provided for parents, with one child commenting that their parents consented to them taking part in the weighing and measuring “because she thinks I am over weight”. Another parent had suggested to the class teacher that perhaps their child had been chosen because they were Polish.
- Many children were comfortable with their experience in general, although a similar proportion of children were not. Even the children who had said they were happy or comfortable with the process were able to suggest ways that it might be improved. These suggestions related to privacy, being taken to a ‘holding area’ and being accompanied by a familiar adult.
- Children appeared to be happy for their parents to receive results of information on their height and weight.
- A number of the children made reference to being ‘the wrong size’ or wanting feedback on whether they were the ‘right’ size. Although for the majority of the children in this sample, the parents had received the results it would appear that these were not communicated to the children. It would seem reasonable that children who had consented to having their measurements taken be given this opportunity.

7.4 Providing BMI results to parents, and its impact

Of 4,202 year 4 children measured in the three sites providing results, results of measuring were requested by parents for 1,722 (41%), see Table 13Table 13.

Table 13. Proportion of parents requesting results of measurements

Pembrokeshire		Flintshire & Merthyr & North Glamorgan
Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 73 of 89	

Wrexham			
Total measured	1033	2081	1088
Requested results	244	877	601
Proportion	24%	42%	55%

7.4.1 Factors influencing numbers requesting results

Influence of consent approach to requesting measurement results

North Wales provided information by whether or not consent was opt-in or opt-out. These confirmed the anecdotal reports from all areas that parents returning an opt-in form were more likely to request results than those in an opt-out area that did not have to return a form. In the opt-in schools measurement results were requested for 522 out of 751 measures (70%). In opt-out areas this was 355 out of 1330 measures (27%). Out of all those offered an opt-in approach, even though fewer take up the option of measurement, more received the results of their children's BMI than out of all those offered an opt-out approach to measurement.

Results requested in relation to gender and BMI category

Pembrokeshire provided a break-down of results requested in relation to gender and BMI category. A similar number of parents of boys (206) and girls (215) requested results.

Families with overweight and obese children requested results as well as those of normal weight (Table 14Table 14). These categories, based on 1990 UK thresholds of 91st and 98th centile are not directly comparable with the results in section 7.1.3 which are based on IOTF (prevalence of obesity is expected to be lower when IOTF is used, however, the 'overweight or obese' prevalence is expected to be similar). There is no impression of any differential uptake in requesting results across BMI categories.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 74 of 89	

Table 14. BMI category by gender among children whose parents requested results, Pembrokeshire

	Girls (n)	Boys (n)	Girls (%)	Boys (%)
Underweight	7	0	3%	0%
Normal weight	150	147	70%	71%
Overweight (not obese)	31	28	14%	14%
Obese	25	30	12%	15%
Missing data	2	1	1%	0%
Total	215	206	100%	100%

For details on attitudes to feedback received, see section 7.3.

7.4.2 General Practitioner survey

15 questionnaires were sent out to GP Practices and initially two were returned. The remaining 13 practices were contacted by telephone and the questionnaire completed with the practice manager over the telephone. 8 practices completed the questionnaire over the phone; three requested the form to be emailed so that they could discuss at the practice team meeting; two practice managers were not available.

Thirteen questionnaires were completed (87%). All of the practices reported that they were aware of the study. None of the practices were able to check with every primary care staff if they had been contacted by a parent regarding their child's results. However, all of the practices reported that the study had not had an impact on the workload of the practice.

Some of the comments made included:

'No impact on practice, staff felt informed and happy about the study'

'Project a good idea and was a sensible way to undertake surveillance'

'Health visitors could have been better involved'

'When the local leisure centre started to measure blood pressure the practice kept having lots of concerned patients turning up, this study had no obvious impact'

'Consider copies of measurement sent out to GPs to update records'

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 75 of 89	

7.4.3 NHS Direct Wales usage

Although 1,722 families received the BMI results, and it is likely that about 30% (~516) were outside the 'normal' range, the only contacts with NHS Direct Wales were:

- 7 hits on the website
- 11 calls to the telephone service, of which only four were answered. Others either hung up during the recorded message while awaiting a receptionist or rang outside of the hours of the service (1 call).

7.4.4 Contacts with nursing staff

One nursing service recorded one call from a parent relating to concerns over their child's weight; and this was in an area not offering feedback of results of measurements.

7.5 Other qualitative feedback

Contacts of families with nursing staff were captured in a number of ways. These include (1) general contact made with staff following a parent's receipt of the consent or results letter, (2) queries or complaints (minimal) made about the process, and (3) information given by a parent choosing not to have their child measured.

These, together with feedback from staff and a summary of the level of disruption as assessed by schools are outlined in Appendix 7. Very few concerns were spontaneously expressed by families; however, when asked why families did not wish to participate, a number of individuals expressed disagreement with the concept of weighing and measuring at school.

A number of problems were identified include use of a previous name for one child due to failure to obtain an up to date school list in advance of calling children from a classroom, and a parents who was unhappy their child was measured and reported they had not seen the opt-out letter.

School feedback suggests that most schools rate disruption caused by measurements as low.

7.6 Cost Assessment

Full details of costs are provided in Appendix 3.

The estimated costs of measurement at a Trust level per 1,000 children measured ranged substantially from approximately £2,500 to £4,807 across the pilot areas (excluding cost of feedback), (Table 15). Table 15 The costs of school visits per child measured were over double that in rural areas than urban/mixed areas. This is likely to be primarily related to the greater distances involved, but may also be related to

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 76 of 89	

high proportions of small schools. The estimation of other costs varied substantially. Depending on the estimate of other costs rurality is likely to increase costs for local aspects of a measurement programme by between 26 and 75%.

Table 15. Costs by area, excluding costs of feedback of results to families

	School visits	Data entry	other	Total	Total per 1,000 children measured
Pembrokeshire	£3,547	£1,575	£2,244	£7,365	£3,546
<i>Flintshire & Wrexham Unadjusted</i>	<i>£1,538</i>	<i>£2,403</i>	<i>£7,822</i>	<i>£11,763</i>	<i>£2,448</i>
Flintshire & Wrexham Adjusted	£2,024	£2,403	£7,822	£12,249	£2,549
Powys	£3,101	£1,217	£5,542	£9,859	£4,807
Merthyr and Cynon valley	£1,502	£1,761	£400	£3,663	£1,571
Swansea	£3,180	£4,028	£4,033	£11,241	£3,921

Two of the three areas that provided results to children gave an estimate of the staff time involved in providing these results. The cost of this staff time was:

- £980 in Pembrokeshire where results were supplied to 421 families, or £2.33 per letter (95p per child measured in this instance)
- £1,134 in Cwm Taf where results were supplied to 601 families, or approximately £1.89 per letter (105p per child measured in this instance).

It is impossible to accurately separate out the costs of measurement in reception year and year four. Whereas measurement of children in reception year is likely to take longer than those in year four, participation in European Surveillance involves collection of additional data items including a 'school return form'. An estimate of the cost of school visits if measurements were undertaken in reception year alone and the additional cost of measurement when year four is also included are provided (Table 16).

Table 16. Estimated cost per 1,000 children measured*

	Reception alone	Year 4 additional	Average cost for a combined reception/year 4 programme
Rural minimum	£4,395	£2,200	£3,297
Rural maximum	£7,830	£5,816	£6,823
Urban/mixed minimum	£2,163	£1,600	£1,882
Urban/mixed maximum	£5,598	£5,216	£5,407

*Rural urban effect estimated through cost of school visits per child in Pembrokeshire and Powys (rural) or Flintshire & Wrexham, Merthyr and Cynon Valley or Swansea (part). Minimum and maximum based on minimum and maximum estimates for other local costs including data entry.

Year 4

A population approach to measuring year 4 by NHS Trusts/Health Boards would incur additional costs.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 77 of 89	

The analyses suggests that the cost of school visits for a joint reception year/year 4 measurement programme might be only about a third higher than a reception year programme alone (due to a reduced average cost per child measured); however, data entry costs per child measured would be expected to increase. Combining these effects the average cost per child measured appears lower when year four is added onto a programme measuring reception year; however, the effect is greater in more rural areas and areas with lower estimated data entry costs.

Substantial staff time is spent in organising the measurements, as well as undertaking measurements and entering data. This needs to be reflected in the cost if the programme is implemented across Wales.

As costs of data entry on the child health system substantially impact the overall cost, ensuring that data processing was as efficient as possible would reduce overall cost. Entering all of the data on one screen which also had instructions would reduce the time taken and this would need input from Health Solutions Wales.

Costs were estimated for providing results to parents by two areas; the costs were estimated at around £2 in staff time per letter produced. It is anticipated that in a future programme any decision to routinely offer results would be accompanied by the development of a system to produce automated letters for families which would be expected to substantially reduce these costs. However, the initial outlay required to produce such a system would require further exploration.

Costs estimated here are on the basis of a population approach to year 4 measurements. If a sampled approach were taken the costs would be substantially reduced as the number measured would be 2,800 every two years rather than an estimated 34,800 children annually in year 4 across Wales. However, this sampled approach would require a separate organisation process outside of the remit of the Trusts/Health Boards, and would therefore need separate funding.

Various central costs are described in more detail in appendix 3; however, an estimate of staff (including on costs) for centrally running a nationally quality assured programme for reception year and year 4, including data cleaning, data analysis and report production are approximately £110,000.

7.7 Literature review

Full results of the literature review to support this work are included in Appendix 5. A summary is given below.

7.7.1 Is BMI a reliable measure of obesity in children?

BMI can provide a general description of the adiposity characteristics of a healthy paediatric population. BMI in children has known limitations. BMI can only give an indirect estimate of total body fat and cannot provide a reliable prediction of health outcomes in the paediatric population. BMI does not take into account skeletal size, amount of body water or muscle mass and it is not gender specific, nor does it reflect the distribution of fat in the body. BMI underestimates the degree of overweight in

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 78 of 89	

particularly short children and overestimates overweight in particularly tall children. Percentage of body fat and fat distribution vary between different ethnic groups. With exception of measuring very tall or short children and considering the ethnic differences, BMI is a reliable measure of child obesity in the population

7.7.2 What is the effect of puberty on BMI?

There is evidence that puberty will affect BMI measured and its interpretation. Onset of puberty is typically between the age of 10 and 14 years in girls and between 12 and 16 years in boys. Studies have variously described (1) that height velocity reaches a peak one year before menarche (the onset of periods in girls), (2) significant differences when comparing BMI of age matched pre-menarche vs post-menarche girls, and (3) that pubertal maturation affects BMI. In boys a study has shown that the relationship between BMI and body fat is more affected by sexual maturation than by age; the reverse was true for girls.

7.7.3 What are parents and children's attitudes to childhood height and weight measuring programmes?

A relatively small number of studies have examined this issue. All identified studies showed that, on the whole, attitudes of parents and children were supportive of a height and weight measurement programme and obtaining feedback, where applicable. In one study children and parents have expressed some concerns but no strong opposition towards the programme or the proposed routine feedback.

Children were generally happy about weighing and measuring undertaken by a doctor, school nurse or a teacher in the study conducted in the UK. However both parents and children had concerns about the privacy of measuring in school. There was no evidence that giving written results of BMI measures to parents gives rise to weight related teasing or bullying.

One particular issue that concerned parents in all the identified research was the protection of privacy of the child's data and sensitivity in the weighing and measuring process. Whereas some studies identified a lack of understanding of BMI among parents, this was not universal. Parents suggested using simple language and a positive tone explaining BMI in a feedback letter.

There is conflicting evidence as to whether or not parents accept or reject a child's overweight status after feedback of results. However, some parents who refused to accept the overweight status of their child reported making healthy lifestyle changes after feedback.

No evidence could be found examining the effect of weighing and measuring on children's body image or in relation to an impact on eating disorders.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 79 of 89	

8 Discussion

Obesity is a major public health problem in Wales. In spite of measures of childhood height and weight being taken in primary schools all over Wales these measures currently cannot be used to monitor trends in heights and weights.

This study is the first time the CCH2000/NCCHD has been utilised to successfully obtain comparable primary school height and weight data from different areas across Wales.

This study has examined a wide variety of aspects of implementing a national programme including measuring over 16,000 children in over 400 schools. The multiple approaches, including randomised allocation of consent, quantitative analysis, qualitative descriptions from children, parents and staff and prospectively collected costing all add to the strength of the study. Contributions from the steering group were essential in directing what was a complex piece of work in an area that initially appears deceptively simple.

The time scales for Trusts and LHBs undertaking this voluntary work were tight, with a number of competing priorities for school services including the introduction of the Human Papillomavirus vaccination during the same academic year. Substantial work was required in understanding issues that arose with the data, as would be expected for a pilot study. Further analyses including analyses of the European form returns should be undertaken at a later date.

Much of the discussion in relation to this study can be found in individual sections of the appendices.

Due to technical problems large amounts of data were absent from one of the Trusts in relation to children not measured. For this reason uptake rates could not be calculated. There are some (more minor) concerns over the accuracy of uptake measures in other areas also. These issues would need to be addressed in advance of roll-out of a national programme.

Although the agreed protocol required pilot sites to visit schools a second time to catch-up individuals absent on the day of measurement, due to the time constraints described, this did not happen for most Trusts.

This study used the International Obesity Task Force obesity and overweight thresholds as these are likely to be used by other European countries participating in the European surveillance initiative, and can be compared with previous work undertaken both in the UK and abroad. England is currently reviewing the best thresholds to use for the National Child Measurement Programme. Whichever definition is used will not affect the feasibility of a programme; however, communication difficulties that can arise from quoting different prevalence rates from the same figures should be considered.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 80 of 89	

Figures based on IOTF thresholds should not be compared with rates derived from other thresholds such as the UK 1990 centile chart, e.g. current results of the National Child Measurement Programme, England.

Whereas most findings of this study are consistent with expectations, and with each other, there were some areas of conflict. In particular, findings of interviews with children suggest that children should be taken individually from a classroom rather than taken as a group to a 'holding area' to ensure privacy. However, staff reported difficulty in obtaining private rooms and practical problems with taking children one at a time from a class, including class disruption.

A national height and weight measurement programme is feasible. However, in order to use the approach we took, a number of issues that need to be addressed were identified within this study. One of the key areas is utilising school lists to ensure CCH2000 data is as up to date as possible for accurate uptake rates.

Legal aspects of the programme should be considered. In the absence of the Health and Social Care Act 2008, the National Child Measurement Programme had previously described the legal requirements for a passive (or 'opt out') approach to consent. The legal implications of any planned future programme should be fully considered.

Rising obesity level has been attributed to an "obesogenic environment" (Foresight, 2007), and many of the interventions that are expected to be effective will address the environment that leads to obesity, rather than focusing on individuals. Although there are some programmes developed to address obesity (such as Mind Exercise Nutrition...Do it! (MEND)), evidence of their effectiveness remains scant.

It is important that any national programme retain a focus on addressing the population level causes of obesity and not blur the lines with a screening programme in trying to trigger interventions for individuals based on a BMI measurement alone.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 81 of 89	

9 Conclusions

9.1 Feasibility of measuring children's heights and weights in schools for population monitoring

1. It is feasible to measure children's heights and weights in primary schools in Wales and derive local authority level prevalence for underweight, overweight and obesity.
2. It is feasible for this information to be derived from measures taken by school/community nursing services, if adequately resourced to do so.
3. It is feasible to utilise the existing NHS Trust data collection systems (CCH2000 and the NCCHD) to collate and store this data, if services are adequately resourced to do so and appropriate quality controls are instituted. Use of the NCCHD allows for a rich level of information which may be used to examine relationship between individual height and weight results over time, and explore relationship with other factors on the NCCHD and other relevant pseudonymised databases.
4. It is feasible to extract information from the National Community Child Health Database for analysis in order to:
 - monitor trends in childhood obesity,
 - provide a basis for population based epidemiological research, and
 - potentially, assess the effectiveness of population based interventions; provided these are designed and implemented in such a way as to allow objective evaluation. This would ideally be through cluster randomised implementation at an organisation or community level.

9.2 Quality of data

5. Height and weight data collected were of a high quality:
 - 100% of records had a date of examination, date of birth and sex within a valid range and over 99% for school code and residence code,
 - BMI was in a valid range for over 99% of BMI measures recorded
6. Some data items were of poorer quality or were difficult to use in their current form for a national measurement programme

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 82 of 89	

- Ethnicity was poorly recorded, varying from <1% in one Trust up to 57%. This data item is recorded at birth and recommendations for improving quality are beyond the scope of this study.
- The 'consent' option on the NCCHD in relation to the fields used for this programme had insufficient options to support fully the requirements of the European Childhood Obesity Surveillance Initiative. Further, accessing the consent file was excessively time consuming for data entry staff. The quality of data from the 'consent' field was too poor to be of value within the study.

9.3 Uptake of measurements (response rate)

7. Estimating accurate uptake rates has been difficult due to (1) poor recording of consent status and (2) technical problems experienced identifying those who were eligible for measurement but were not measured. This is particularly the case at the Flintshire and Wrexham site, whose results have been excluded. An analysis of the European 'school return forms' was used to corroborate the uptake findings. These issues must be overcome in developing any national programme.
8. Measurements in reception year (or year one) are well established across Wales. Uptake of measurements in reception year was high (90%-96%) in reception year among those Trusts using an opt out approach, and a little lower in the area using an opt-in approach to measurement: 86%. This compares very well with rates of uptake in England of 48% in 2005/6 and 82% in 2006/7 (Crowther et al, 2007; Dinsdale, 2008).
9. In year 4, uptake rates were substantially higher among schools randomised to an opt-out approach rather than opt in (87% vs. 59%; relative risk 1.46, $p < 0.001^3$). A broadly similar pattern (89% vs. 56%) was seen from analysis of European return form data; although these data are known to be incomplete.

9.4 Proportion of children overweight or obese

Note: Overweight / obesity measured using the International Obesity Task Force BMI criteria.

10. The proportion overweight or obese was 22.2% in reception year. The proportion overweight or obese in year 4 was 26.4% among schools randomised to an opt in approach, and 28.5% among schools randomised to an opt-out approach. The BMIs of less than 100 of the 14,100 children measured were classed as underweight.

³ Analysis does not take account of the effect of clustering.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 83 of 89	

11. At a local authority level (including North Wales) the proportion classified as overweight or obese in reception year ranged from 21% to 24%. In year 4 the range was much greater; over 40% of girls in Merthyr Tydfil were classified as overweight or obese.
12. On average the measured prevalence of obesity was higher among schools randomised to opt-out consent; overall however this difference was not statistically significant (odds ratio 1.1, p 0.061).
13. Overweight and obesity are higher in the most deprived compared to the least deprived in all groups included (reception year, opt-in and opt-out year 4 groups).

9.5 Attitudes towards measuring programme

14. Although many children were comfortable with their experience in general, a similar proportion of children interviewed were not. Children's experience could be improved by ensuring privacy throughout the process, including avoiding use of a 'holding area', and having the option of being accompanied by a familiar adult. The emphasis on privacy is common to other work undertaken with children and this is reflected in the literature review.
15. Children interviewed were not aware of the reasons why measurements were taken. Adults and staff were mostly aware that the purpose was related to population monitoring; however, for both there were difficulties involved in separating such a programme from taking height and weight measures to manage individual children.
16. Staff appeared to have more concerns over whether consent was opt-in or opt-out than parents. There was a sense from many parents that it was expected that children would have their height and weight measured at school.
17. Both children and parents expressed an interest in knowing the results of measurements
18. Staff found the programme was work intensive, especially providing results to parents (feedback forms).
19. Staff reported that children engaged in the process of measuring and emphasised the importance of the role of the child.
20. From reasons provided by parents on why they did not wish their child to participate in the measurement programme, it is clear that some of these individuals objected to height and weight measures being taken on school children (see section 7.5; Appendix 7).

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 84 of 89	

9.6 Providing results of measurements

21. Of the 4,202 children whose parents were offered BMI results 1,722 (41%) requested feedback. Where an opt-in approach was used a parent was much more likely to request feedback (as this involved ticking the box in a form being returned for measurement). Gender and BMI category did not appear to substantially influence whether or not an individual requires feedback.
22. Receiving results of BMI, including categorisation into underweight, normal weight, overweight or obese, did not appear to result in parents contacting health services (GP practices or NHS Direct) for support in this study.
23. Review of the literature suggests that although BMI is a useful clinical tool, it has limitations. In particular it varies with ethnicity, muscle density and, in children, the height of the child (overestimating obesity among taller children within an age group). The long term health outcomes from childhood obesity are less well understood than those of adult obesity.
24. Parents and children both expressed an interest in knowing the result of measurements. Parents have a right to know the results taken on their children and if the measurements are taken in order to derive BMI results and it is reasonable to expect any such feedback to include BMI.
25. Parents interviewed who received the results of their children's BMI were in general happy with the format in which they were supplied.
26. This study could not assess whether providing BMI feedback to parents in written form does more good than harm.

9.7 Impact on services

27. Providing results of height and weight measurements appeared to have minimal or no impact on health services; apart from the direct resource required to issue the results:
 - A dedicated support line and website was set up for parents with queries following receipt of their results. Use of these facilities was minimal to non-existent.
 - There was only one recorded contact in relation to the programme. from a family concerned with the weight of their child
 - There is evidence from this study that providing results of measurements to parents does not impact on general practice workload.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 85 of 89	

9.8 Participation in European Childhood Obesity Surveillance Initiative

28. A population coverage approach to year 4 measurements as piloted in this study could contribute to the European Childhood Obesity Surveillance Initiative
29. In order to contribute fully a number requirements include the ability to collect additional data items; and improved quality control systems for collection of information such as the Mandatory School Return form.
30. The surveillance initiative is currently planned to take place every two years, with the next round of collection in the next academic year (spring 2010). Most, but not all, participating countries use a sampled approach; requiring measurement of 2,800 children in a particular round.

9.9 Cost assessment

31. Costs per 1,000 pupils measured for a combined reception year/year 4 measuring programme at the local level were estimated as between £3,300 and £6,800 per 1,000 pupils measured in rural areas, and between £1,900 and 5,400 per 1,000 pupils measured in urban/mixed settings.
32. Inclusion of year four in European surveillance above and beyond a reception year only measurement programme would involve extra data collection, with add-on costs. Nonetheless, as staff would travel to schools for measurement in reception year the additional cost per child in year 4 was estimated to be less than the cost per child in reception year alone. This is particularly the case in more rural settings.
33. Staff cost of production of feedback were estimated at around £2 per letter produced. Development of automated systems to produce such letters from existing systems would reduce existing costs. Benefits from provision of this information at an individual level in terms of health gain are unknown.
34. Staff (including on costs) for centrally running a nationally quality assured programme for reception year and year 4, including data cleaning, data analysis and report production are approximately £110,000.

Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 86 of 89	

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Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 87 of 89	

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Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 88 of 89	

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Version: 1a	Submitted to Assembly: 22.06.2009 Minor amendments: 07.06.2010	Status: Final
Authors: Public Health Observatory for Wales	Page: 89 of 89	