Obesity Surveillance of children in Ireland

nnsc National Nutrition Surveillance Centre

A Hub for Data Collation, Research, Education & Communication

Tenth in a series of position papers

December 2009

This work was carried out by the National Nutrition Surveillance Centre, University College Dublin, in partnership with the Health Service Executive (HSE), as part of the HSE Framework for Action on Obesity

Introduction

In 2005 the Report of the National Taskforce on Obesity set out a series of recommendations for the Health Sector to stop the rising levels of overweight and obesity in the Irish population (Department of Health and Children 2005). One of the recommendations under the remit of the HSE, Population Health Directorate was to develop "a national database of growth measurements (height, weight, waist circumference, BMI) for children and adults…. in order to monitor prevalence trends of growth, overweight and obesity". It was suggested that existing surveillance systems be examined and redeveloped where necessary to incorporate the required data rather than establishing a new model of data collection. Such systems are available for collection of adult health data, namely the National Health and Lifestyle surveys, which have produced population health data every four years since 1998 and, most recently in 2006, provided measured BMI data of over 2000 nationally representative adults (Harrington, Perry et al. 2008). While repeated self-reported BMI data is available for children from the Health Behaviour in School Aged Children (HBSC) survey there has not been a repeated, systematic collection of measured height and weight data of children in Ireland. As in other areas of health policy, protection and promotion of child health is critical and therefore provision of surveillance data on overweight and obesity in children is a priority of the HSE, Population Health Directorate. A group was convened to examine the feasibility of developing a childhood obesity surveillance mechanism in Ireland. Several areas of exploration were suggested by the group one of which was to examine childhood obesity surveillance mechanisms in other countries, to identify models of best practice and also to identify previous Irish data collected on childhood weight or height. This report aims to provide an overview of these two areas and also recommendations for progress in the area of childhood obesity surveillance in Ireland.

Discussion around any area of obesity will invariably begin with a description of the most appropriate means of defining overweight and obesity simply because of the variation in measures and standards used in different settings. This report will therefore follow suit and describe the methods most appropriate to measurement of obesity in Irish children at the population level.

Measurement of overweight and obesity

"Obesity refers to a state where excess fat is stored in adipose tissue" (Seidell & Visscher, 2004). Body fat can be measured directly by estimating the total body fat mass and various components of fat free mass. Direct measurement of obesity is very difficult, requiring highly specialized techniques such as underwater weighing, magnetic resonance imaging (MRI), computerized axial tomography (CT or CAT) and dual energy X-ray absoptiometry (DEXA). Recent advances have also lead to the use of air-displacement plethysmography which measures the total body volume in addition to body weight, and allows for the calculation of fat and lean body mass. These techniques are generally confined to research and clinical settings and are expensive to perform.

Anthropometric techniques measure relative fatness or adiposity and include waist, hip, skinfold thickness and measures derived from weight and height such as Body Mass Index (BMI) or the ponderal index. The prevalence of obesity is most commonly assessed through Body Mass Index (BMI) which is defined as weight (kg)/height squared (m^2). It is widely accepted that for measurement of individuals BMI measurement is limited by the fact that it cannot distinguish between fat and muscle mass (Wells, Treleaven et al. 2007). BMI can only give an indirect estimate of total body fat and cannot provide a reliable prediction of outcome (Speiser, Rudolf et al. 2005). It is not a sensitive measure of body fatness in people who are particularly short, tall or have an unusual body fat distribution. It may also misclassify athletes with low body fat percentage but high muscle mass. However, for the purposes of large scale studies and population data BMI is a simple and inexpensive measure of body fatness (Prentice 1998). The ideal application of BMI is when height and weight are measured by a trained individual although self-report in BMI has been demonstrated to be useful (Goodman, Hinden et al. 2000). Measurement of height and weight is non-invasive and is generally accepted by the individuals being measured. There is low observer error and good reliability and validity(Lobstein, Baur et al. 2004). Additional anthropometric measures of body fatness are important to consider in conjunction with obesity.

Waist circumference is an indirect measure of central adiposity. It is an easy simple measure with inexpensive equipment, has low observer error, offers good reliability, validity and low

measurement error (Lobstein, Baur et al. 2004). It may be useful in identification of current or future risk of certain conditions such as heart disease but it does not benefit the present identification of the fattest children beyond what is measured with BMI. In addition there are no accepted cut-off values for the classification of overweight and obesity based on these measures. Therefore it is arguable whether waist circumference should be routinely included in surveillance for childhood overweight and obesity.

1. Classification of overweight and obesity

In adults the WHO recommends that a person with a BMI of 25 kg/m^2 or above is classified as overweight while one with a BMI over 30 kg/m^2 or above is classified as obese.

The relationship between BMI and body fatness in children is influenced by age, sex, pubertal status and ethnicity. Defining overweight and obesity in children requires the use of population reference data and established cut-off points to relate BMI in terms of age and sex. There has been a lack of consensus on the definition of BMI in children therefore various cut-off criteria have been proposed based on reference populations.

1.1. BMI for age reference charts

Established reference data which are set at a point in time are used to describe secular trends in obesity. The data should be representative of the population being described. There has been some debate about using current data but updating growth charts would obscure secular trends (Reilly, Dorosty et al. 1999).

- **US CDC 2000**

This growth reference was constructed using pooled data across several national surveys by the National Centre for Health Statistics (NCHS) in 1977. At that time the US charts were also adopted by the World Health Organisation for International use and prior to the introduction of the UK 1990 charts most countries used the American reference data. The growth charts were updated in 2000 on recommendation from the NCHS with more recent and comprehensive national data collected as part of the National Health and Nutrition Examination Survey (NHANES) which periodically measures height and weight of the American population since the 1960s.

- **WHO growth standards**

After prolonged use of NCHS references internationally researchers observed that growth patterns for breastfed infants did not follow the same pattern as that of formula fed infants and breast fed infants appeared to fall behind in terms of the growth reference charts. In

1990 the WHO initiated research to collect new data and develop standards for optimal growth for infants and children. This led to the development of the WHO Multicentre Growth Reference Study which included growth curves for children under 5 years who were breastfed and born to non-smoking, healthy mothers who were from a high socioeconomic group thereby defining growth and health on an optimal basis(de Onis, Onyango et al. 2006). The data was collected from Brazil, Ghana, India, Norway, Oman and USA and resulted in the publication of the WHO Child Growth Standards in 2006. These standards have been adopted by numerous countries worldwide but they have not been adopted in Ireland.

- **WHO growth references**

In 2007 the WHO published estimates of the growth of children aged between 5 and 20 years which are based on US data. Use of one and two standard deviations as cut-offs using this reference would increase the number of children classified as overweight and obese compared to the IOTF system (James and Lobstein 2009).

- **UK 1990 reference**

The UK 1990 reference charts were constructed from over 25,000 children from seventeen different nationally representative datasets ((Freeman, Cole et al. 1995) collected between 1978 to 1993. These charts have demonstrated high validity (Rudolf, Sahota et al. 2001) and are widely acknowledged as being the most appropriate for use in the UK. The references have since been reviewed as a result of the increasing prevalence of overweight and obesity, and since half of the children measured were formula fed it was agreed that in Britain they would used the WHO growth standards for children aged 0 to 4 years but retain the UK 1990 reference data for older children. In May 2009 new UK-WHO Growth Charts were introduced for clinical use with newborns and new referrals.

- **Growth charts in Ireland**

There has been much discussion in relation to growth references charts used in Ireland. Currently we have Irish height and weight standards for children aged 5 to 19 years (Hoey, Tanner et al. 1987) but there is no data available for children under 5 years. It has been recommended that the new UK-WHO references are used for this age group but there is no consensus on this recommendation at present (HSE, 2009). The Irish standard data are used currently in the clinical setting and the HSE proposes to develop new growth charts for use in Ireland.

1.2. BMI for age percentile cut-offs

The definitions of childhood obesity above a certain percentile is an arbitrary decision and is not based on known medical or health risk (Dietz and Robinson 1998). Different definitions are used depending on the reference data used.

The UK Department of Health has recommended that the 98th (Z score > 1.342) and 91st centiles (z score > 2.054) of the UK 1990 reference chart for age and sex are used to define obesity and overweight for routine clinical use as they have relatively high sensitivity and specificity (National Institute for Health and Clinical Excellence (NICE) 2006). These cut-offs are therefore appropriate for assessing and monitoring individual children.

The majority of epidemiological research uses a definition of obesity as a BMI of more than the 95th centile (z score > 1.645)and overweight as a BMI greater than the 85th centile (z score >1.036) compared to 1990 BMI UK reference data. According to this method, the percentage of children who were overweight or obese in the UK in 1990 are established at 5% and 15% respectively (Barlow and Dietz 1998; Prentice 1998) Increases over 5% and 15% in the proportion of children who exceed the reference 85th/95th percentiles over time indicate an upward trend in the prevalence of overweight and obesity.

In the United States, BMI-for-age above the 95th centile are defined as overweight and BMI-for-age centiles between the 85th and 95th percentiles are labeled 'at risk of overweight'.

1.3. BMI based on adult cut-off points

An alternative method for measuring childhood obesity is the International classification. This method links child and adult obesity by use of centiles which pass through adult BMI cut-offs allowing continuity from childhood. The IOTF developed this system based on data collected from six countries (Brazil, Hong Kong, the Netherlands, Singapore, Great Britain and the USA (Cole, Bellizzi et al. 2000). The resulting sample was comprised of 190,000 subjects in total aged 0 to 25. The BMI percentile curves that pass through the values of 25 kg/m^2 and 30 kg/m^2 at age 18 were smoothed for each national dataset and then averaged. The averaged curves were then used to provide age and sex specific BMI cut-off points for children and adolescents aged 2 to 18. The benefit of this approach is that it allows international comparisons of levels of obesity in children to be made.

Averaging centiles of several countries may, however, have certain drawbacks. Chinn and Rona (2002) have highlighted that the international definitions may not be appropriate to use with national data as they exaggerate the difference in prevalence between boys and girls, particularly in children under 5 years (Chinn and Rona 2002). Other concerns have been raised about sensitivity of the IOTF values which are adequate at the lower overweight cut-

off but are less robust at the obesity cut-off values (Reilly, Dorosty et al. 2000). In addition, the limited sample size of the reference population and the lack of BMI cut-offs for underweight may restrict their application. Chinn and Rona (2002) recommended that, for single country studies, definitions which are compatible with national reference curves are more appropriate (Chinn and Rona 2002).

Z-scores

BMI z scores or standard deviation scores compared to reference values provide a relative measure of adiposity adjusted for age and sex and minimizes the effect of varied time between baseline and follow-up. The BMI z scores are calculated relative to an external reference (whether national or international) and not to an internal reference. A positive change in z score from baseline to follow-up indicates an increase in relative BMI over the time interval.

BMI z scores and percentiles are interchangeable and either can be used to define overweight and obesity. However, if a continuous measure of adiposity is required BMI zscores are more appropriate. Z scores are also more robust in statistical analyses and should be used as the analytical variable as opposed to adjusting crude BMI for age and sex (Must and Anderson 2006). Use of Z scores is appropriate to evaluate changes in BMI in the individual but may not provide additional benefit at a population level.

2. Measuring overweight and obesity in the population

2.1. Monitoring overweight and obesity

Development of effective health policies depends on the availability of good data. While obesity data can be extrapolated from research it is routine surveillance that will provide the most robust information (Wilkinson, Walrond et al. 2007). Monitoring and surveillance efforts are intended to discern population subgroup differences and/or trends in diet or nutritional status over time by systematic repeated measurements.

Surveillance is described as the continuous and systematic process of collection, analysis, interpretation and dissemination of descriptive information for monitoring health problems (Buehler 1998). Although the two terms are used interchangeably Byers (1998) has described a distinction between monitoring and surveillance:

"*Monitoring implies the collection and analysis of quantitatively precise measures from representative samples of a population for the purpose of precisely tracking trends.*

Surveillance implies a system of less precise measures intended to trigger timely interventions in response to the detection of meaningful trends". (Byers 1998)

Monitoring systems tend to be part of large population samples with direct measures of diet and nutrition and anthropometry whereas surveillance systems examine smaller samples that are not necessarily representative and use more perfunctory measures. The distinction is therefore defined by the differences in quantitative accuracy of the measures, by differences in the size of the population studied and the timeline of the analysis. The term 'growth monitoring' in children is often used interchangeably with obesity surveillance. Growth monitoring programs are usually conducted at a population level and monitor overweight and underweight children as well as those who are of short or tall stature. The monitoring programmes are generally designed to identify individuals within a population who are at risk of a growth disorder.

A review of growth monitoring in children, was conducted by Fayter et al. (2007) to clarify the role of growth monitoring in primary school children, including obesity, and to examine issues that might impact on the effectiveness and cost-effectiveness of such programmes. The studies reviewed were evaluated based on their effectiveness of detecting obesity and other growth disorders according to the UK National Screening Committee criteria. The reviewers concluded that since obesity does not meet the criteria for screening and

“identification of effective interventions for the treatment of obesity is likely to be considered a prerequisite to any move from monitoring to a screening programme designed to identify individual overweight and obese children”. In addition there are no clear recommendations as to how the target population of any monitoring programme should be defined and there is very little research on the benefits and harms of monitoring.

2.2. Obesity screening

In terms of public health, a clear distinction must be made between a surveillance system and a screening programme for obesity. Screening involves an examination to identify people who are at risk of having a disease- the people who are discovered are then treated. Little is known about the outcomes of BMI measurement programs, including effects on weight-related knowledge, attitudes, and behaviors of children and their families. In 1993 a strict monitoring programme was introduced by the Ministry of Education in Singapore which had a legal requirement for all children to be screened annually (Fu, Lee et al. 2003). The children identified at the upper end of the BMI spectrum were then engaged in a programme which involved strict interventions such as staying after school and eating lunch separately from other children. Parents were also required to change the diet of their children and schools were penalized if they were found to have children who were obese. The initial outcome of the programme saw notable reduction in the prevalence of obesity but in 2007 the programme was stopped by parents who believed their children were being stigmatized by the intervention efforts.

A recent paper by Wake et al. found that primary care screening followed by an intervention aimed at improving nutrition and physical activity did not demonstrate improvements in the BMI of the children aged 5 to 10 years (Wake, Baur et al. 2009). As a result, no consensus exists on the utility of BMI screening programs for young people. At present obesity does not meet the usual criteria for the development of a screening programme as described by Wilson and Junger (1968). Screening may only be of value under the following conditions:

- The identified obese individuals are ready for further assessments and are willing to make changes to achieve a healthy weight.
- The capacity for further assessment and treatment is available in the community
- Effective intervention and follow-up programmes are accessible and available for the obese individual (Lobstein, Baur et al. 2004).

The U.S. Preventive Services Task Force have stated that insufficient evidence exists to recommend for or against BMI screening programs for youth in clinical settings as a means

to prevent adverse health outcomes (Whitlock, Williams et al. 2005) however, the American Academy of Pediatrics (AAP) (2003) recommends that BMI should be calculated and plotted annually on all youth as part of normal health supervision.

2.3. Obesity Surveillance

Surveillance systems aim to obtain data to generate population health information on epidemiological trends. The data is collated to observe subgroups rather than individuals and may be used for planning and developing regional or local programmes and therefore there is no requirement for referral for treatment or additional follow-up for individuals. Regional data can then be fed into a national data collation system to provide a national picture of the health problem. The BMI measurements collected at the population can however be used for both surveillance and screening purposes.

German et al. (2001) described a number of parameters which indicate the need for surveillance of a health-related event:

- Indices of frequency
- Indices of severity
- Associated inequities
- Costs associated with the health-related event
- Preventability
- Potential clinical course on the absence of intervention
- Public health interest

Obesity meets all of these criteria which urges the need for national surveillance systems to assess the prevalence and incidence of both overweight and obesity and examine their trends over time (Caroli et al., 2007).

3. Surveillance systems in practice

Annual school health assessment is obligatory in most western countries with height and weight measurement being integral to most mechanisms and used for monitoring child growth regionally and nationally (Toschke, Grote et al. 2004; Werner, Bodin et al. 2006). Other countries employ regular national childhood nutrition surveys to estimate trends in overweight and obesity (Wang, Ge et al. 2000; Matsushita, Yoshiike et al. 2004; Andersen,

Lillegaard et al. 2005). The various methods of gathering height and weight data in the United States are described below to illustrate the possible methods of obesity surveillance in children. In Europe there are currently only three countries that have purposefully designed routine childhood obesity surveillance systems – Finland, Malta and England. The system in England will be described in more detail here.

3.1. US

In the United States, there are many interconnected efforts to systematically collect information about the health and nutritional status of the population. Many of the surveillance systems and surveys designed to assess child obesity have been in place for 10 to 15 years. A report by the Food and Nutrition Board, Institute of Medicine has described the major surveillance systems conducted in the US (see Table1) which generally cover the school setting (Institute of Medicine 2006) . Most obesity-related activity in childhood is conducted through schools as this is where children spend the greatest portion of their time. Schools in the US, however, are governed by various levels from local school boards to towns or districts. Several States have introduced legislation which aims to enhance a healthy school environment. Arkansas was one of the first states to enact legislation where BMI is measured on all pupils (Ryan, Card-Higginson et al. 2006) as part of a statewide data-monitoring public health surveillance system to track obesity in the population of children and adolescents. Initially, the act required that the BMI percentile was recorded in each child's report card but this proved contentious for several reasons - namely because it was apportioning blame on the individual student but also because parents found it difficult to interpret. The Act was subsequently changed to disseminate the information in a separate health report. A cardiovascular-risk screening programme in West Virginian schools has measured BMI over the past 10 years in conjunction with an intervention programme which provide comprehensive child health reports to parents (Harris and Neal 2009).

In 2005 the Institute of Medicine provided recommendations for schools to prevent child obesity one of which was to conduct annual assessments of each student's weight, height and gender and age-specific percentile and make this information available to parents. Following this the IOM called on the federal government to develop guidance for BMI measurement programs in schools. With guidance from an expert panel, the Centers for Disease Control and Prevention (CDC) developed a report to help inform decision-making on school-based BMI measurement programs (Nihiser, Lee et al. 2009).

Despite the availability of data there are limitations in the data on different age groups and the size and representativeness of the samples surveyed in the various systems. For instance, since most surveillance systems are school based pre-school children are not

directly engaged with formalized obesity prevention programmes. The Institute of Medicine recommends that self-assessment tools, such as the School Health Index, could be expanded and adapted for preschools, child-care and after-school programs and disseminated through relevant professional associations and organization. The Pediatric Nutrition Surveillance System collects height and weight measures of preschool children but this system is not nationally representative as it samples low-income children.

Opportunities for linking datasets is another area which has not been fully explored in the US and which, using the same methodologies, could allow for tracking of various obesity-related outcomes over time. Researchers in this area have suggested that public health surveillance data collected by states "fostered a heightened awareness and concern that drove policy changes"(Dietz, Story et al. 2009).

Table.1 Examples of US Federal Programs for Supporting and Monitoring the prevention of Obesity in Children and Youth

Survey	**Organisation**	**Age group**
Cross-sectional		
National Health and Nutrition Survey (NHANES)*	CDC (2005)	Adults and children
National Health Interview Survey*	CDC	Household level
National Longitudinal Survey of Adolescent Health	Carolina Population Center	Grades 7 to 12
M**o**nitoring the Future	University of Michigan	Grades 8, 10, 12
Paediatric Nutrition Surveillance System (OedNSS)†	CDC	0 to 5 years
School Health Policies and programs Study	CDC	All
School Health Profiles	CDC	Secondary Schools
School Nutrition Dietary Assessment Study	USDA	Elementary and Secondary Schools

Youth risk factor behavior surveillance system†	CDC	Grades 9 to 12
School Health Index	CDC	All
Longitudinal Surveys		
National Survey of Children's Health (NSCH)	Maternal & Child Health Bureau, National Center for Health Statistics	0 to 17 years
National Survey of Early childhood health (NSECH)	MCHB, American Academy of Paediatrics	4 to 35 months
National Longitudinal Survey of Youth	US Dept of Labour	12 to 16 years

Evaluation availability: *In progress, † Available

Source: IOM, 2006

3.2. England

The National Child Measurement Programme (NCMP) (formally known as the National Obesity Database) was established in 2005 and is one of the largest programmes of its kind in the world. A directive from the UK Department of Health issued guidance to Primary Care Trusts on how to measure child-hood obesity, requiring initiation of systems to measure height and weight of primary school children aged 4-5 years and 10-11 years. These two specific indicators of child obesity align with the Vital Signs indicator on child obesity. Every school year, these indicators of obesity inform local planning and delivery services for children, and gather population-level surveillance data to allow analysis of trends in growth patterns. The programme also seeks to raise awareness of the importance of healthy weight in children. The NHS Operating Framework requires all PCTs to develop plans to tackle child obesity, and to agree local plans with strategic health authorities (SHAs). There are also other indicators within the NIS that are relevant to tackling child obesity and that work towards the national ambition. These include: breastfeeding, take-up of school lunches, the emotional health of children, children and young people's participation in high-quality physical education and sport, and travel to school.

Initial findings from the Child Measurement Programme were published in 2006 (Crowther, Dinsdale et al. 2006) and a number of practical difficulties were identified. These included technical difficulties such as the transfer of data from the Primary Care Trust to the national

database but issues around selection bias where overweight children may have opted out of being measured. These areas were highlighted and addressed with the result that in the following year there was an increase in participation rates from 48% to 80% with improved data quality and greater confidence in the findings.

Additional routine data on adult obesity is collected by GPs. The Quality and Outcomes Framework for 2006/078 includes an indicator which rewards practices for maintaining an obesity register of patients (aged 16 and over) with a BMI greater than or equal to 30 recorded in the previous 15 months. The recording of BMI for the register takes place in the practice as part of routine care.

The United Kingdom also has other cross-sectional health survey data used to examine trends in obesity. The Health Survey for England (HSE) is an annual survey, monitoring the health of the population which is currently commissioned by the Information Centre (the IC). Children from infancy to aged 15 living in households are selected for the survey. Trend tables are published each year updating key trends on a number of health areas. Each survey in the series includes core questions and measurements such as blood pressure, anthropometric measurements and analysis of saliva and urine samples, as well as modules of questions on specific issues that vary from year to year. The Scottish Health Survey and Welsh Health Survey look at adults and children in those regions. The National Diet and Nutrition Survey (NDNS) describe the dietary habits and nutritional status of the population of the Britain. Originally it was comprised of cross-sectional surveys covering the whole population from age 1½ years upwards, split into four different population age groups. : children aged 1½ to 4½ years (fieldwork 1992/93), young people aged 4 to 18 years (1997), adults aged 19 to 64 years (2000/01) and people 65 years and over (1994/95). In 2008 the survey began a rolling programme which will run continuously with field work every year covering a representative sample of adults and children (Food Standards Agency). Several longitudinal studies have also examined obesity including the National Child Development Study, the Millennium Cohort Study, the Avon Longitudinal Study of Parents and Children (ALSPAC)

3.3. WHO

The WHO Global Database on Body Mass Index (BMI) was developed as part of WHO's commitment to implementing the recommendations of the WHO Expert Consultation on Obesity: Preventing and Managing the Global Epidemic (Geneva, 3-5 June 1997), which identified the lack of nationally representative cross-sectional data as an obstacle for

facilitating international comparisons of adulthood obesity rates, monitoring the magnitude of the current and future obesity problems, and evaluating the effectiveness of intervention strategies.

The Department of Nutrition for Health and Development (NHD) initially developed the WHO Global Database on BMI to provide a systematic collation of available nationally representative and sub-national adult overweight and obesity data. These are reported in a standardized manner using WHO recommended BMI cut-off points to produce internationally comparable results.

During the last four years, the database has evolved in close collaboration with Food and Agricultural Organization (FAO), as a global interactive surveillance tool to monitor nutrition transition covering and reporting on the entire spectrum of adult nutritional status. Currently efforts are being made to undertake a systematic collection of nationally representative studies that also include underweight. The Dietary Energy Supply (DES) data are displayed in conjunction with the BMI data on the maps and in the charts. DES figures are produced by FAO based on Food Balance Sheets (FBS).

WHO Europe

On 30 May 2007, the Commission released a white paper that outlined its commitment to collaborating with WHO in following-up the European Charter on Counteracting Obesity by developing a nutrition and physical activity surveillance system for the 27 countries of the European Union and participating in the development and implementation of the Second WHO European Action Plan for Food and Nutrition Policy.

The WHO European Action Plan for Food and Nutrition Policy (2007-2012) includes, as one of its specific action areas, the establishment of national and international surveillance systems on nutritional status, food availability and consumption, and physical activity patterns in different age and socioeconomic groups, including early childhood. The plan stated that the measurement of nutritional status should include anthropometry and micronutrient status; dietary intake should consider macronutrients, micronutrients and breastfeeding and complementary feeding should be monitored (section 2.2.4).

Data presented on BMI by European Union (EU) countries, collected by Eurostat uses the Health Interview Surveys (HIS). The HIS data are collected in different years depending on the country, ranging from 1996 to 2003. There is no fixed periodicity in these kinds of health survey and few countries have an annual survey on these topics.

4. Irish research data on obesity in children

The first Irish survey designed specifically for surveillance of childhood obesity commenced in Ireland in 2008. The survey is part of the WHO European obesity surveillance initiative which is an ongoing, systematic process of collection, analysis, interpretation and dissemination of descriptive information for monitoring obesity. The system will be aiming to measure trends in overweight and obesity in children aged 6.0-7.9 years. The programme uses standardized protocols and sampling framework in order to have a correct understanding of the progress of the epidemic but also allowing inter-country comparisons within the WHO European Region. The aim is to repeat the survey at 2 year intervals. Data is accompanied by supporting information about the schools food and physical activity environment (some elements of this are optional).

Data records on heights and weights of 14,835 Irish children are available from the 1948 National Nutrition Survey (DOH, 1952). No further population data on weight in children was published until the Irish National Nutrition Survey (INNS), in 1990. This was a cross-sectional and nationally representative survey conducted in 14 primary schools (Lee and Cunningham, 1990) providing measured height, weight of 148 8 to 12 year old children. A study of Irish teenagers was conducted by Hurson & Corish (1997) which included lifestyle and dietary information in addition to weight, height and skinfold thicknesses of 390 secondary school pupils aged between 12 and 18.

The Health Behaviour in School Aged Children Surveys has provided childhood obesity prevalence estimates every four years since 1998. The most recent survey collected data from 10,334 pupils aged 10 to 17 years olds and 3,404 nine year olds (new in 2006) using European standardised self-completion questionnaires (Nic Gabhainn et al, 2007). The BMI derived from the HBSC studies are based on self-reported heights and weights which, may have has implications for the accuracy of the data but has been used and validated by other countries for determining obesity prevalence. Validation studies have found a high correlation between self-reported and measured weights and heights in school children (Andersen at al., 2005). The distinction of the HBSC study is that it has enabled secular trends in BMI to be observed and also the relationship with sociodemographic status and other health behaviours in children such as alcohol use, self-esteem and bullying.

Griffin et al, (2004) followed up a group of 251 healthy 11-12 year olds over a one year period. Weight, height, waist circumference and triceps skinfold were measured in addition to body image perceptions, satisfaction and slimming patterns of the cohort. As part of a study on dietary supplements in secondary school children Byrne (2003) collected height

and weight data on 390 15 to 18 year old adolescents from 9 schools distributed between Dublin and Wexford

Cross-sectional data on measured childhood BMI is available from the National Children's Food Survey (IUNA, 2005). The survey includes height, weight, waist and hip circumference and leg length measurements from a nationally representative sample of 596 children aged 5–12 years. The measurements were conducted in conjunction with a semi-weighed 7-day food diary which provides the most accurate picture of Irish children's diets to date. Research conducted by O'Neill et al (2007) has described the secular trends of Irish school children using the archived data from the 1948 and 1990 national surveys as the same measurement methodologies were conducted in all studies. IUNA has also recently completed a teen survey which provides similar data on adolescent school-going children.

National epidemiologic surveillance and the proper study of time changes require representative studies with minimal selection bias (Werner & Bodin, 2007). Longitudinal studies of nationally representative samples make it possible to conduct analyses both within and between cohorts over considerable periods of time. Longitudinal research of healthy populations is in its infancy in Ireland.

The National Longitudinal Study of Children in Ireland, also known as 'Growing up in Ireland' is a Government-funded initiative. The study will monitor the development of 18,000 children – a birth cohort of 10,000 and a 9-year-old cohort of 8,500 children - yielding important information about each significant transition throughout their young lives. Several measures of health status are included in the study including body mass index. In July 2009 measurement of height and weight was conducted as part of an interview with the children aged 9 years and these children will be followed up again in 4 years time

A longitudinal study of adolescents was recently completed in three schools in Cork. Close to 200 secondary school students aged between 12 and 17 were studied over 3 years from 2005 to 2007 (O'Connor et al., 2008). Study measurements included changes in body mass index, anthropometric measures, dietary intake and physical activity.

The Lifeways Cross Generation Cohort study aims to examine physical and social risk factors of cardiovascular disease through the lifecourse. It was the first Irish study to follow children from the antenatal stage through to early childhood. The study involves 1124 mothers who were recruited during their pregnancy and agreed to participate in the study with their child for an initial 5 year period. It is currently the only Irish study to have data on health, diet and socioeconomic factors during pregnancy with longitudinal information on both the mother and child. One of the unique features of this study is that information is also

available from at least a third of grandparents allowing for cross-generational analyses to be performed. Self-reported height and weight measures are available for the mothers, fathers and grandparents at the start of the study. Infant birth weight, length and head circumference is available and measured height, weight and waist circumference was collected at the five year follow-up stage.

4.1. Measurement of BMI in the Irish healthcare setting

The studies described above were designed to conduct heights and weights measurement of children as part of their overall research objectives. Other research is conducted in the health care setting. In some health settings this is integral to ongoing work whereas in other areas opportunistic measurement of heights and weights was undertaken by interested health professionals.

The Statutory national core child health programme includes recommendations for growth monitoring of all children age 0 to 12 years in Ireland. Growth monitoring identifies those children who are not only overweight but underweight and those with growth disorders who are tall or short stature. Appropriately, it does not include a screening process for overweight and obesity. At present children universal monitoring at birth, 6 to 8 weeks, 8 to 12 months and at school entry is part of routine clinical care. In 2001 the national recommendations were piloted in Co. Leitrim and parts of Co.Cavan. School nurses from the original North Western Health Board (now HSE North West) conducted height and weight measurements in addition to testing of visual acuity and hearing. The national recommendations for growth monitoring were revised in recent years by the HSE Programme for Action for Children – Best Health for Children Revisited (2005) and stated that “due to inequities in the resourcing and delivery of this programme, no systematically universally available growth monitoring currently exists for children in Ireland”. A working group on growth monitoring developed best practice guidelines for measuring children which included a recommendation to focus on accuracy of measurement and therefore limit the mandatory measures to three stages of development (at birth, 6 to 8 weeks, and school entry). Other opportunities for measurement , however, should also be utilized. The core child health programme includes assessment for development, hearing, vision, and medical matters at birth, postnatal, 6 to 8 weeks, 3 months, 7 to 9 months, 18 to 24 months, 3.25 to 3.5 years, school entry and exit.

In 2004–2005 a group of 74 Mayo primary schools were included in a project which aimed to look at using the schools health programme to measure heights and weights of young children. The sample included 718 children from senior infant class who were measured as an additional part of the routine school health check. The study revealed that BMI data

obtained through the school health programme can be used to monitor national trends in obesity and overweight (Glacken 2005).

In 2001 the National Survey of Children's Dental Health in Ireland was representative cross-sectional sample of 4 to 16 year old children Irish children. As part of the dental health survey the research team used this setting to opportunistically measure heights and weights of these children with a resulting sample of 19,617 school-going children from the island of Ireland.

5. Guidelines for the establishment of obesity surveillance programmes

Lobstein (2004) has described certain characteristics which are necessary when establishing formal obesity surveillance programmes (Lobstein, Baur et al. 2004). They should be:

- Owned and used by governments to assess progress towards target for childhood obesity, eating and physical activity behaviours and environments.
- Regularly implemented and assured of sustainable funding
- Potentially serve as the comparison group for effectiveness studies
- Monitor the reach, sustainability and population impact of programmes
- Potentially used for benchmarking purposes
- Measure the key outcomes and determinants of interest:
    - Height, weight, waist
    - Eating behaviours and attitudes
    - Physical behaviours and attitudes
    - Key nutrition-related environmental factors
    - Key physical activity-related environmental factors

Wilkinson (2007) also identified a number of similar core dataset requirements which included:

- Prevalence indicators: height, weight, waist, age, gender
- Predictor indicators; ethnic group, disability, fitness, deprivation indicator
- Intervention indicators: habitual diet intake, physical activity/fitness level, associated co-morbidities, smoking status (Wilkinson, Walrond et al. 2007)

Other indicators relevant to tackling child obesity recommended by the UK National Heart Forum included include: breastfeeding, school lunches, the emotional health of children, participation in high-quality physical education and sport, and travel to school.

Irrespective of the establishment of an explicit ‘surveillance’ mechanism the fundamental elements of any national epidemiological monitoring initiative are described by Werner:

1. A representative population sample
2. Few missing subjects which are not systematically different form the remainder of the sample
3. The methodology used should be repeatable to allow for measurement over time.
4. The data must be valid and precise (Werner, Bodin et al. 2006).

5.1. Key Issues

Consent and parental feedback

The aim of obesity surveillance is to describe the epidemiologic patterns of obesity not to identify individual children at risk. While monitoring of obesity in the health care/school setting has potentially the greatest scope for describing the epidemic there are contentious issues surrounding identification of overweight and obese children and informing parents, similar to a screening programme. However, consent for using data for statistical and research purposes is not necessarily sought and according to the Data Protection Act, 1988 the use of such anonymised data is permitted (Mc Master et al., 2005).

The National Child Monitoring Programme in the UK has a legal basis to routinely feedback to parents on an opt-out basis through the Health and Social Care Bill. Research that looked at parental attitudes to the NCMP suggests that most parents would like feedback from the programme, as it may be useful for monitoring a child's health, or as an aid to teach families about healthy weight. Other research by the Health Behaviour Unit, based at University College of London, suggests that providing feedback to parents might have a positive effect on family behaviour and eating habits in the home.

Initial experiences of a screening programme in Arkansas found that parents and the national press were depicting the BMI percentile as a 'grade' which created some resistance to the programme and parents had concerns over the invasive aspect of the assessment. The school health professionals were not fully trained to communicate effectively with parents at the outset of the programme and the health messages were not fully developed.

Sensitivities around measuring children

Research in Ireland conducted in schools showed that young children were not concerned about having their weight and height measured. Older children reported that they would not be concerned with having their weights and heights measured as long as it was conducted in private and the results were not shared with anyone.

Children respond pragmatically and positively to being weighed and measured if the measurement is done sensitively. Privacy while being measured is important to both parents and children. Staff should be aware that children can be sensitive about their height or weight, or both, and recognise that weighing and measuring children could accentuate these sensitivities, particularly for older children.

Research conducted by the UK National Childrens Bureau found that the majority of children aged 4 years and under did not fully understand the concept of being weighed and measured in school. The children in this age group that did know what it meant (some said they had been measured at home to see how tall they were growing) were unconcerned or indifferent about the intervention.

Most of the 5 year old children understood what being weighed and measured involved. Children between 5-8 years of age viewed being weighed and measured as a common activity and a normal part of 'growing up'. Some remembered being measured or weighed in maths lessons or at the doctors. However, some children expressed anxiety about being teased or bullied.

9 and 10 year old children demonstrated more awareness of what the process entailed and could imagine potentially uncomfortable situations arising from the intervention. They expressed anxiety in relation to how they would receive the intervention as well as how other children who might be 'fatter', 'thinner', 'taller' and 'shorter' than 'normal' might feel.

The general view was that it is important to know about the link between weight and health and how to eat and exercise properly and that being measured and weighed provided an opportunity to learn about how to be healthy. Privacy was an important issue for the children in order to reduce any embarrassment and prevent teasing or bullying – 'where people won't look through' (Girl, 10 years). They said being kept fully informed, before and during the intervention, would help to reduce their anxiety too.

In 2007, the UK Department of Health commissioned research on parental attitudes towards the National Child Measurement Programme. Parents generally valued feedback of the height and weight data as well as information on whether the child is a healthy weight or not. The report found that attitudes towards the exercise were generally positive. However, advance information, the choice to opt-out and the provision of feedback were deemed important elements of a measurement programme. Parents generally felt that provision of the height and weight with an information leaflet about healthy lifestyles would be informative and helpful and such information could be put into practice by parents.

An American study of parental perceptions of BMI screening in West Virginian schools found that parents believed that obesity was a matter for parents to address rather than schools (Harris and Neal 2009). Their primary concerns around measuring BMI in schools were that children would be embarrassed or stigmatized; that measurement may lead to an increase in eating disorders; discomfort with the schools involvement in family diet and lifestyle; a preference to receive health care information from the family physician(Harris and Neal 2009). However the factors that led some parents to have concerns about screening were the same factors that incentivized other parents to provide their consent.

Further research is required in relation to Irish parents' attitudes to measuring BMI in children in schools and possible changes in attitudes from measuring children preschool in the community or health care setting to the school setting.

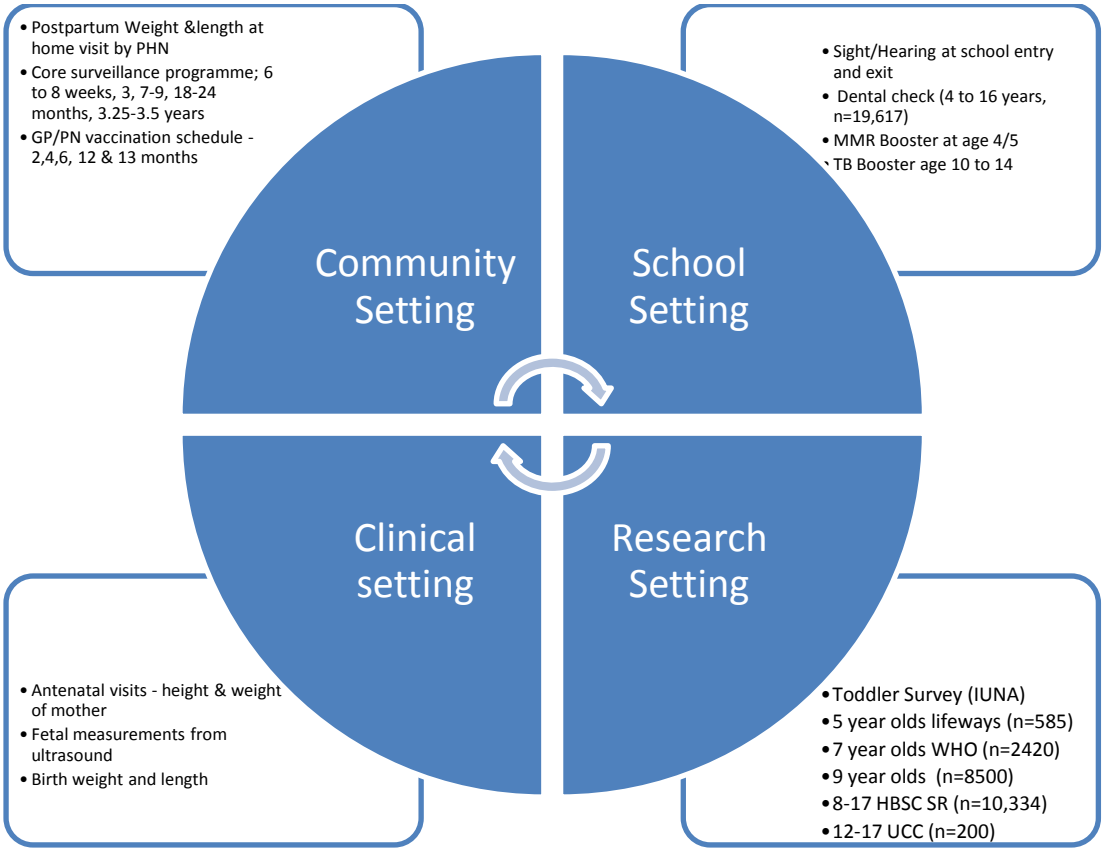
Appropriate settings for obesity surveillance

The 1970 Health Act established provision of health services for all children up to the age of 6 weeks. Under section 66 of the Act children are entitled to free health examinations and treatment in national school. Current screening and surveillance mechanisms are outlined in Table 2 however there is no standardized approach to the delivery of these services across different health regions.

Table 2: Core Child Health Programme

Timing	**Developmental**	**Hearing**	**Vision**	**Medical**	**Growth monitoring**
Birth	✓	✓	✓	✓	✓
Postnatal	✓	✓	✓	✓	✓
6 to 8 weeks	✓	✓	✓	✓	✓
3 months	✓	✓	✓	✓	✓
7 to 9 months	✓	✓	✓	✓	✓
18 to 24 months	✓	✓	✓	✓	✓
3.25 to 3.5 months	✓	✓	✓	✓	✓
School entry	✓	✓	✓	✓	✓
School exit	✓	✓	✓	✓	✓

Routine measurement of childhood weight and height can be conducted effectively in a variety of settings. The current opportunities for routine measurement are outlined in Figure 1:



While the opportunities outlined in Figure1 are available the community, clinical and school settings the services may not be consistent in all settings. In clinical settings each maternity hospital conducts and records routine measurements according to varying protocols. Birthweight is one measure which has been collected and recorded systematically in maternity hospitals but the documentation of other anthropometric measures at birth varies between maternity units. One simple example of this is the measurement of weight and length at birth which is recorded in birth charts but in some hospitals only the weight is entered onto the electronic database system. Birth weights and other useful clinical and demographic information are recorded on the Birth Notification registration system which is completed by the hospital and required by the General Register of Births. This form is also used by the Director of Community Care and the Medical Officer of Health in the mother's area of residence to provide community health and social care with the mother and new born infant. This system is currently used for screening and surveillance services in Ireland. This system is also linked with the National Perinatal Recording System of the Economic and Social research Institute.

Another information system which could provide details on child health is in place in several health authorities is the Child Health Information System (CHIS). There are several different versions of CHIS in practice but the operating principle is the same. Hospitals forward birth details of the infant to the central CHIS office including mother's Personal Public Service number, contact details and some physical information including birth weight. The details are then forwarded to a local CHIS office within the relevant local community care area. There are several different sections to CHIS including the immunizations. Within this system the mothers are contacted to remind them of the vaccination schedule and their GPs are contacted via the community care area, who then contact the mothers to remind them of the vaccination schedule. Inclusion of heights and weights measurement during immunization visits is an ideal opportunity to collate BMI data which would automatically be processed centrally.

Glacken has demonstrated that it is possible to collate appropriate measures using the irish school health screening system for children aged 6 in senior infants (Glacken 2005). McMaster et al have previously conducted analysis on the feasibility of using the statutory school health screening programme to generate data on overweight and obesity in Irish children (McMaster, Cullen et al. 2005). As evidenced by the WHO surveillance programme and the research conducted by McMaster there are issues in relation to the broad age ranges in classes particularly in rural schools where class sizes are small. However, the appears to be little requirement to introduce additional surveillance measurements at the primary level as the WHO surveillance programme provides data on 7 year olds and the Growing up in Ireland study includes measures for 9 year olds.

The ages which require most attention are the preschool children and post primary adolescents. There are issues surrounding measurements in post-primary children in terms of consent, stigma and also it can be very difficult to compare adolescents due to different growth rates. However there will be some data from the Growing up in Ireland study on 13 year olds. Multiple opportunities exist for the measurement of preschool children, however for surveillance purposes, how this data is captured, processed and managed requires further attention.

The linkage of all child health information would not only provide a better picture of child health in general but would also enable health professionals, educators and parents to establish how the child is developing. .Introduction of an infant/child record managed jointly by the community healthcare team and parents in the first year of life and subsequently by the parents would greatly enhance this surveillance process. Parent-held child records have been strongly recommended for over 10 years as evidenced by the review of child health

services in the 'Best Health for Children' report (1999) which recommended an overall model of parent and child centred care. Improvements in data capture technologies may facilitate the collection of this type of information by parents and health professionals. It may also be timely to actively promote the establishment of a patient identification number or personal health record which could greatly improve the administration of health services in the population. Research into parents views on measurement of heights and weights of their children and on the implementation of a unique health identifier may facilitate this process.

Resources

The introduction of a surveillance programme has considerable resource requirements. The direct costs include equipment, staff, facilities, training, and data management. At present, most clinicians do not have formal training in screening, counseling, or treatment for child and adolescent obesity Appropriate staff training ensures accuracy and precision of measurement technique to produce valid growth data. However, considerable resources are currently available in relation to standardized measurements in Ireland as part of the Child Health Screening and Surveillance Service Training and more recently the UK Royal College of Paediatrics and Child Health training information and resources became freely available online. Training structures are already in place within the HSE as part of the curriculum development in child health including Regional Child Health Training and Development Officers and tutors. Uniform policy on the equipment used would minimize variations observed from different instruments..

Training of non-health professionals could relieve burden. Previous studies have shown that trained volunteers can measure children as accurately as health care professionals (Welch, 1982;). In some situations trained members of the local community maybe more acceptable to children, especially those of different cultures or ethnic groups. In his paper on measuring BMI in children Himes states that "experience shows that an advanced formal education is not required to take high-quality anthropometric measurements. Willing adults who will give adequate attention to detail and who meet the requirements for employment are usually satisfactory" (Himes 2009). In the Arkansas Experience, while there was a state requirement of one school nurse to every 500 pupils, they found that Physical Education teachers were particularly engaged and became advocates for the programme (Thompson and Card-Higginson 2009). The key to successful implementation of the programme was achieved through collaboration with school administrators, nurses, PE teachers, parental advocacy groups, and regional health departments.

Measurement issues

Repeated anthropometric measures over time allow for calculation of a growth rate and can be used to identify patterns of growth. These measures however will only be useful with precise measurements. The principal sources of measurement error are due to normal child and seasonal variation which are difficult to standardize but can be adjusted for in analysis of BMI. Observer variation will always be present but should be minimzed to achieve as close to mean interobserver differences of 0.3cm (SD 0.2cm) for height and 0.02kg (SD 0.03kg) for weight (Roche and Sun 2003). As outlined earlier, adequate training can reduce some measurement errors while the use of correctly installed and calibrated instruments should be mandatory to minimize instrument generated error (Fayter et al., 2007). Random errors will not affect group means of height, weight and BMI and will not affect the prevalence of overweight or obesity in children since as many children should be classified above and below the percentile cut-offs for age and gender (Himes 2009).

A standardized training programme already exists in Ireland as part of the Programme for Action for Children which established national standards for public health nurses and doctors for measurement techniques and equipment (HSE, 2005).

Terminology

The acceptability of conducting child measurements may also be affected by the terms used to describe the programme. Researchers in the UK and the US have found that the terms ‘obesity’ or ‘overweight’ are viewed negatively by the general public and may therefore lead to low levels of consent. Similarly, in the US it was suggested that the term ’surveillance’ may appear to be negative or threatening to parents and children. However, alternative terminology should not minimize the potential harm of overweight and obesity in children.

Legalities

If parental feedback is required then there may be a need for legislative change including clear and specific legal basis for the monitoring or surveillance programme. In the UK the NCMP legal basis means that weighing and measuring does not have to be undertaken by a “health professional” and it may be worth exploring similar approaches in this country.

Collation of data

A data management strategy is essential for the effective and efficient collation of surveillance data. Anonymised data can be entered into a secure web-based system that can be centralised and used to determine prevalence rates. . Centralised double entry of data would also reduce entry error and ensure data protection. If standardized measurement

and techniques applied then data from multiple sources may be pooled to provide greater numbers to estimate prevalence rates and relevant epidemiological data.

Dissemination of surveillance evidence

The traditional routes for research dissemination should be utilized to inform researchers and professionals of epidemiological outcomes. Innovative mechanisms should also be explored particularly in smaller, non-academic settings where obesity-related research is being conducted but there are no evaluations or published results. Mechanisms to incentivize evaluation and dissemination practice have been proposed particularly in the school setting (IOM, 2007)

Conclusion

There is currently a lot of activity in the area of obesity in Ireland as evidenced by the Report of Inter-sectoral Group on the Implementation of the Recommendations of the National Task Force on Obesity (2009). However, it is difficult to estimate if there has been substantial changes in the prevalence of obesity in our children without the systematic collection of height and weight measures. The WHO surveillance work conducted in 2008 provides an opportunity to provide accurate estimates of the problem and must be repeated on a regular basis to enable us to track the trends. Several opportunities are available within both the health and education sectors for data collection however the main area of contention is whether the measurements are conducted accurately and with true precision particularly with the number of individuals conducting these measurements. The other issue in terms of monitoring trends is how the data is collected and managed within the child health programme and whether this data can be accessed and utilized in a standardized manner to monitor national trends. The use of research data by the various academic and health institutions may offer more accurate data collected by trained researchers however there are few studies which have repeat measures for children and there are some age groups where there is little anthropometric data available. Data representativeness and quality must be ensured to enable national epidemiological monitoring that provides accurate trends of weight status in Irish children.

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