The Childhood Obesity Surveillance Initiative (COSI) in the Republic of Ireland: Findings from 2008, 2010 and 2012

An Roinn Sláinte
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nnsc National Nutrition Surveillance Centre

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THE CHILDHOOD OBESITY SURVEILLANCE INITIATIVE (COSI) IN THE REPUBLIC OF IRELAND: FINDINGS FROM 2008, 2010 AND 2012

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FOREWORD

I very much welcome the findings of this research, undertaken as part of the World Health Organisation (WHO) European Childhood Obesity Surveillance Initiative. To date, three waves of surveillance among Irish school children at 7 years, 9 years and 11 years have been completed in 2008, 2010 and 2012. This has enabled us to build up a picture of the weight status of Irish children and how their weight changes as they mature.

The results show that 1 in 4 Irish children are either overweight or obese, which remains an alarming statistic on which we continue to focus our work. However, the data also shows an encouraging early indication of a stabilisation of overweight and obesity among 9 year olds and a continued reduction in both overweight and obesity among 7 year olds. Finally, and critically, this overall reduction in incidence is not seen among 7 year old Irish children attending the Department of Education and Skills designated disadvantaged schools, where there has been no improvement over time.

Healthy Ireland, a Framework for Improved Health and Wellbeing 2013-2025, seeks a whole of government and whole of society involvement to proactively improve the health and wellbeing of the population. We know that obesity is a significant risk factor for the development of chronic diseases and certain cancers, and we know that obesity tracks strongly from childhood into adulthood bringing with it all the inherent risk factors for the development of future chronic illness. We also know that disadvantaged communities have a higher incidence of obesity than their more affluent peers.

The Health and Wellbeing Division of the HSE will play a lead role in implementing health specific actions in Healthy Ireland by supporting the population to experience physical and mental health and wellbeing to their full potential through:

- **increasing the proportion of people who are healthy at all stages of life,**
- **reducing health inequalities,**
- **protecting the public from threats to their health and wellbeing, and**
- **helping to create an environment where every individual and sector of society can play their part in achieving a healthy Ireland.**

Healthy weight management must occur at each stage along the life course if we are to successfully achieve a population shift away from our current tendency towards unhealthy weight gain. To increase the likelihood of success, and to intervene as early in a child's life as possible, we are introducing childhood growth screening as part of the school health check for 5-6 year olds. Identifying children at risk will allow us to offer assistance to those children and families in promoting weight maintenance in the growing child. Those children already clinically obese will be offered a community based lifestyle intervention programme.

I would like to thank the National Nutrition Surveillance Centre, University College Dublin School of Public Health, Physiotherapy and Population Science who were commissioned to carry out this research, and the Department of Education and Skills who kindly facilitated the Initiative by allowing access to a nationally representative sample of schools. I particularly want to thank all of the children who participated in providing body measurements and their parents for giving their permission.

Dr. Stephanie O'Keeffe,
National Director of Health and Wellbeing,
Health Service Executive

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EXECUTIVE SUMMARY

The prevalence of obesity in children is rapidly rising, leading to many serious consequences worldwide. In 2005, the World Health Organisation (WHO) Regional Office for Europe issued recommendations and guidelines for regular collection of data on weight, height, and waist and hip circumference in children worldwide in order to monitor prevalence trends of growth, overweight and obesity. The Department of Health and the Health Service Executive commissioned the National Nutrition Surveillance Centre, based at the School of Public Health, Physiotherapy and Population Science in University College Dublin, to carry out this surveillance work in the Republic of Ireland.

This report presents the findings from three waves of the WHO Childhood Obesity Surveillance Initiative survey in the Republic of Ireland in 2008, 2010 and 2012. In 2008, 163 randomly selected primary schools participated in this project and in the first round the protocol as set out by the WHO for participating countries was followed. The target age was children aged exactly 7 years. In the subsequent two waves, the same WHO protocol was followed and the same schools were contacted again and this time, as well as 7-year-olds, 9-year-olds were also selected for participation in the second round. In the third round, 7-year, 9-year, as well as 11-year-olds were included.

This means that there are three cross-sectional surveys of 7-year-old children, two cross-sectional surveys of 9-year-olds and one cross-sectional comparison group of 7-, 9- and 11-year-old children. Using a unique identifier there are also two cohort groups of the same children followed on two separate occasions from ages 7 to 9 and ages 9 to 11, respectively. In this report, we also compare the data on 9-year-old children to the findings from the Growing Up in Ireland Cohort study.

KEY FINDINGS

- **Over the three waves, data of in total 12,236 examinations are available. In the first data collection round (2008), 163 Irish primary schools participated. In the second (2010) and third (2012) data collection rounds, 152 and 159 schools participated, respectively. In 2008, 2,630 students from First class had their height, weight and waist circumference measurements recorded. In Round 2 (2010), 2,013 First class students were examined. In Round 3 (2012), 1,729 First class and 1,945 Third class students had their measurements recorded.**
- **When categorised by International Obesity Task Force standards, the percentages of overweight (including obesity) 7-year-old boys were 18.3%, 16.2% and 14.4% for the first, second and third rounds, respectively. For girls, these percentages were 26.4%, 25.7% and 21.4%, respectively. The percentages of obese 7-year-old boys were 4.7%, 3.8% and 2.2%, respectively. For girls, these percentages were 7.5%, 4.6% and 5.5%, respectively. These figures show that levels of overweight and obesity improved over time in 7-year-old children across the three waves of the survey (p-value for inverse trend=0.045 for overweight boys, 0.039 for overweight girls, 0.018 for obese boys and 0.063 for obese girls). However, this benefit is not observed in the Department of Education and Skills designated disadvantaged schools, where there has been no improvement over time.**
- **The percentages of overweight (including obesity) 9-year-old boys were 19.7% and 20.0% for the second and third rounds, respectively. For girls, these percentages were 23.2% and 22.0%, respectively. The percentages of obese 9-year-old boys were 4.4% and 4.1%, respectively. For girls, these percentages were 4.8% and 4.3%, respectively. These rates of overweight and obesity in 9-year-old children show no change between the second and third round. In addition, there is no difference between 9-year-old children in the current study and 9-year-old children in the Growing Up in Ireland Cohort study. This suggests a persistent pattern over time and between surveys for 9-year-old children.**
- **A small shift of decreasing levels of overweight and obesity is observed in longitudinal data. Of the overweight and obese boys and girls who were in First class in 2010, 16-25% became either normal weight or overweight respectively when in Third class in 2012. Of the overweight and obese boys and girls who were in Third class in 2010, this percentage was even higher ranging from 30-42%.**

To conclude, it seems that the prevalence of overweight and obesity in Irish primary school children aged 9 has stabilised. Among 7-year-old children, prevalence seems to have fallen, however, this was not observed for children attending disadvantaged schools.

INTRODUCTION

BACKGROUND

The prevalence of obesity in children is rapidly rising. The World Health Organisation (WHO) estimated that in 2010, 43 million children aged 0-5 years were overweight or obese, reflecting a global prevalence of 6.7%. In 1990, this figure was 4.2% and according to current trends, is estimated to increase to 9.1% in 2020 [1]. Between 15-32% of European school children were overweight or obese [2], and at least 30% of English children were overweight or obese in 2010 [3].

These increased rates in obesity have led to many serious consequences globally. It is estimated that about 2-4% of national health funds are directly spent on adult obesity in the European Union [2]. For the Republic of Ireland, the direct and indirect costs of overweight and obesity in 2009 were estimated at €1.13 billion [4]. There is an alarming emergence of pre-diabetes, type 2 diabetes, hypertension and sleep apnoea in children where previously these conditions were seen predominantly in older populations [5-8]. Obesity also affects children's psychological well-being and inter-personal relations [9]. In the long-term, overweight and obesity statuses track into adulthood [10] and are associated with an increased risk of developing chronic diseases such as diabetes, coronary heart disease, stroke, and cancer (endometrial, breast, and colon) as well as an increased risk of mortality [11-15]. Overweight and obesity furthermore predispose children to a variety of cardiovascular risk factors in adulthood. The Bogalusa Heart Study linked childhood obesity to early pathological vascular changes [16] and associated overweight in adolescence with hypertension and lipid and cholesterol abnormalities in later adult life [17]. A cohort of 276,835 Danish children found body mass index (BMI) to be linearly associated with future coronary heart events [18]. Moreover, observational study data has linked obesity in pregnancy with adverse maternal and infant outcomes [19, 20]. These include a higher rate of early miscarriage and congenital anomalies, including neural tube defects, a higher risk of pregnancy-induced hypertension and diabetes mellitus, proteinuric pre-eclampsia, delivery by emergency caesarean section and spontaneous intrauterine death, while children born to obese mothers have a higher incidence of having a birth weight above the 90th centile and are more susceptible to obesity in adolescence and adulthood.

In 2002, the Irish North South Survey established baseline data on the prevalence of overweight and obesity among 4 to 16-year-olds. The prevalence of overweight and obesity among boys was 23% and 28% among girls [21]. The National Children's Food Survey conducted between 2003 and 2004 reported that the prevalence of obesity in boys ranged from 4.1 to 11.2% and in girls from 9.3 to 16.3% depending on which definition of obesity was used. This represents a two to fourfold increase in obesity in Irish children aged 8-12 years since 1990, again depending on the definition of obesity used [22]. Two smaller but more recent Irish studies reported similar prevalences of overweight and obesity at 24.6% for data collected in 2007 in children aged 4-13 years [23] and at 27% for data collected between 2004 and 2007 in children aged 6 [24]. The National Taskforce on Obesity (2005) [25], reported that in Ireland over 300,000 children are estimated to be overweight and obese and this is projected to increase annually by 10,000.

This growing problem of obesity in children is not unique to Ireland and in 2005 the WHO Regional Office for Europe has issued recommendations and guidelines for regular collection of data on weight, height, and waist and hip circumference in children worldwide [26]. Preventing the rise in levels of overweight and obesity is a challenge to the Irish government. In 2005, The Department of Health published the report of the National Taskforce on Obesity [25].

As part of its plan for tackling obesity, it recommended that:

'A national database of growth measurements (height, weight, waist circumference, BMI) for children and adults should be developed by the Population Health Directorate in order to monitor prevalence trends of growth, overweight and obesity. The database can be created by developing the surveillance systems to collect the required data, for example the national health and lifestyle surveys, established longitudinal research projects and the school health surveillance system.' (recommendation 4, 5).

As a result, in 2008 the Department of Health and the Health Service Executive (HSE) commissioned the National Nutrition Surveillance Centre (NNSC) based at the School of Public Health, Physiotherapy and Population Science in University College Dublin (UCD) to commence this surveillance work among primary school children in the Republic of Ireland. The following two rounds in 2010 and 2012 were commissioned by the HSE. Furthermore, the NNSC was commissioned by the HSE to compile and update a national database on adult and childhood growth measurements. This report will focus only on the surveillance work among primary school children.

AIMS AND OBJECTIVES

The Irish childhood growth surveillance system is an ongoing, systematic process of collection, analysis, interpretation and dissemination of descriptive information for monitoring obesity, identified as a serious public health problem [2] in the WHO European Region and for use in programme planning and evaluation [26].

The system aims to measure trends in overweight and obesity in children aged exactly 7, 9, and 11 years in order to have a correct understanding of the progress of the epidemic in Ireland, while also allowing inter-country comparisons within the WHO European Region. The implementation of a simple, effective and sustainable surveillance system will be important to provide valuable information to be able to tackle and monitor the obesity epidemic in children, identify groups at risk and evaluate the impact of obesity preventive interventions.

In this context, it is important to highlight that surveillance is not equivalent to screening. Screening means applying a test to a defined group of persons in order to identify at an early stage, a risk factor, or a combination of risk factors of a disease - the people who are found are then treated. By contrast, surveillance collects anonymised data in a representative sample of people to monitor trends and for policy and planning purposes.

At baseline, the core objective was to measure in primary school children aged exactly 7, 9, and 11 years:

- Weight, height and waist circumference to allow estimation of BMI and the prevalence of underweight, normal weight, overweight and obesity.

STUDY DESIGN

The WHO European Childhood Obesity Surveillance Initiative (COSI) is a collaborative study with principal investigators from all countries co-operating in relation to survey content, methodology and timing using a European protocol. The Irish surveillance system is based on WHO COSI protocol and the Irish representative is Dr Nazih Eldin, HSE lead on obesity. Strict adherence to the original protocol was required for inclusion in the European database and this procedure was achieved with the current study.

During Round 1 in 2008, 163 schools consented to take part in this study and children in First class (in third year after enrolment) were measured. Only one First class per school was sampled, even if there were multiple First classes in a school. The first report describes in detail the cluster-sampling procedure that was followed [27]. Those same 163 schools were contacted again for Round 2 and Round 3 for data collection in 2010 and 2012, respectively. In cases where the school participating in the Round 1 was a junior school, the senior schools were approached as well during Rounds 2 and 3. Junior schools include Junior infants, Senior infants and First class, whereas senior schools include Second till Sixth classes. One of the goals of the subsequent rounds was to follow up the children measured previously. Therefore, in Round 2 (2010) not only First class was included, but also Third class and in Round 3 (2012), First, Third as well as Fifth class were included. Also for Rounds 2 and 3, only one class from each year was selected per school.

SUBJECTS

The children in First, Third and Fifth classes were chosen because these classes include children with the exact ages of 7, 9 and 11 years, respectively. Of course not all children in the target classes are at that exact age, a variable that could not be determined in advance, therefore all children in the target classes were measured. These age groups precede puberty and eliminate possible differences between European countries which may be attributed to variations in the age of puberty [28]. Also, at these ages the identification of obesity is of value to predict the condition in adulthood [29]. Other studies in Ireland also monitor 7-year (UCC Dental Survey and National Children's Food Survey), 9-year (UCC Dental Survey, Lifeways Study, Growing Up in Ireland Cohort Study and National Children's Food Survey) and 11-year-olds (National Children's Food Survey); so at a national level there is information available across these age ranges.

METHODS

ETHICAL CONSIDERATIONS

On all three occasions (2008, 2010 and 2012), ethical approval was obtained from the Research Ethics Committee, Human Research Sub Committee, UCD.

Consent was obtained on three separate levels: at school, parent and child level. Prior to data collection in 2008, an initial letter and a consent form were sent to principals in which the objectives of the surveillance system were explained. A final number of 163 schools consented to participate in this study in 2008. Subsequently, all parents from the sampled classes with the selected age groups in participating schools were given a letter explaining the surveillance system and the anthropometric measurements. An informed consent form was also given to parents. Parents were fully informed about all study procedures and their informed consent was obtained on a voluntary basis prior to the child's enrolment to the study. On the day of the measurement, verbal consent was also obtained from the child. The exact same procedure was followed for Round 2 (2010) and Round 3 (2012).

To ensure confidentiality for all collected and archived data, unique identification (ID) numbers were assigned to each child and each register refers only to these numbers. The research team alone has access to the full list of ID numbers and corresponding names of the children sampled, which is held separately from the examination data. The original hardcopy records are also anonymised, e.g. by removing the child's name, and stored in locked cabinets in UCD and used only for reference if required. These hardcopy records will be destroyed after seven years.

All information and consent forms for parents/guardians were approved by the Irish National Adult Literacy Agency (NALA). They were also available in Irish and this translation was conducted by a professional translator. Moreover, for Round 1, Polish forms, translated by a professional translator, were available.

TRAINING AND STANDARDISATION

For Round 1 (2008), 30 graduate nutritionists were recruited to carry out the fieldwork. For Round 2 (2010) and Round 3 (2012), 15 and 17 nutritionists were recruited, respectively. All researchers attended a training session in anthropometric measurement and data collection, following a standardised protocol drawn up by the WHO. The initial training included a review of the background and objectives of the surveillance system, standardised use of the forms, obtaining measurements of subjects as described in the protocol, support of children with anxieties, calibration of measurement instruments, recording measurement values immediately after reading them and writing legibly to reduce mistakes during data transfer.

ANTHROPOMETRIC MEASUREMENTS

Measurements were carried out over as short a period of time as possible and data were not collected during the first two weeks of a new school term or immediately after a major holiday. For Round 1, measurements commenced two weeks after the Easter break on the 10th April 2008 and continued until the 26th June 2008 (11-week period). For Round 2, measurements commenced on 11th October 2010 and continued until the 29th November 2010 (7-week period). For Round 3, measurements commenced on 8th November 2012 and continued until the 30th January 2013 (12-week period with a 4-week break for the Christmas holidays).

Anthropometric measurements were carried out following standardised procedures for weight, height and waist circumference. For Round 1 (2008) and Round 2 (2010), SECA 872 weighing scales and the SECA 214 portable stadiometers were used throughout. For Round 3 (2012), HD-305 Tanita weighing scales and Leicester Height Measure portable stadiometers were used throughout. For all three rounds, weighing scales were calibrated prior to the start of the data collection. Waist circumference was measured in 2008 and 2010 using a non-elastic metal tape with blank lead-in and in 2012 using a non-stretchable plastic tape with a clear plastic slider with cursor line.

Children can be very sensitive about their own size and those of children around them, which was an important planning consideration for the research team [30]. Measuring height, weight and waist circumference could accentuate these sensitivities and arguably might increase the risk of stigmatisation and bullying. To minimise any potential for harm or discomfort, all measurements were therefore done either in a private room or behind screens to ensure confidentiality and privacy. The nutritionists worked in pairs and were all female. Children were asked to wear normal, light, indoor clothing without shoes. Hair ornaments were removed and ponytails undone and all children were asked to empty their pockets.

Weight was measured in kilograms, to the nearest 100 gram unit (0.1 kg). The stadiometers were mounted at a right angle between a level floor and against a straight vertical surface (wall or pillar). Children's height was measured in centimetres and the reading taken to the last completed 1 millimetre (mm). Waist circumference was measured in cm and recorded to the nearest mm.

OTHER DATA

Individual information on date of birth, date and time of measurement, gender, clothes worn when measured, as well as data on school year, school name and school address were also collected through the core data collection form. Furthermore, verbal permission was asked of the child before the measurements were taken and recorded.

An additional form was also completed by the teacher or principal. The mandatory school return form reported on the location of the school, the number of children registered and measured (examined) per sampled class, the number having refused to be measured and those absent on the measuring day. Additionally, a number of school (environmental) characteristics were also included, such as the frequency of physical education lessons, availability of school playgrounds, the possibility of obtaining certain foods and beverages on the school premises and current ongoing school initiatives organised to promote a healthy lifestyle (healthy eating, physical activity).

During Round 2 (2010), parents were asked if they would like to fill in a Family Survey form as part of the study, which was returned separately to UCD by post. Through this survey, information regarding the child's diet and physical activity pattern and family's socioeconomic characteristics and co-morbidities were obtained. During Round 3, only parents of the First class cohort were asked to fill in this Family Survey form, since data of the Third and Fifth class cohorts were already measured in 2010. A further report on these data will be published subsequently.

FEEDBACK TO PARENTS AND CHILDREN

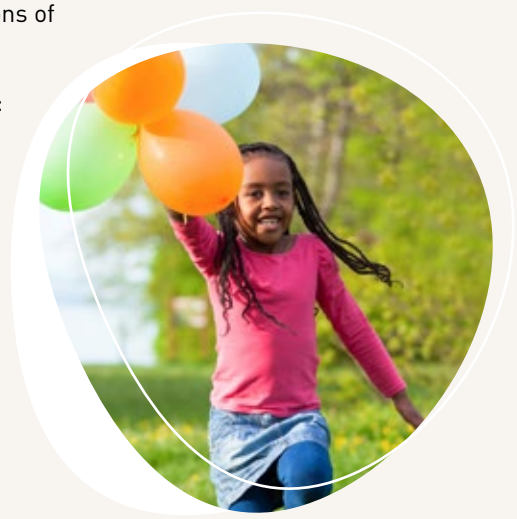
Although their child's height, weight and waist circumference measurements were not routinely given to parents, they were given if requested. Children were never told their measurements or the measurements of other children. Children were able to see their weight on the scales during measurements, but not their height and waist circumference. Research showed that children find it acceptable to be measured in school as long as the measurements were taken in a private room and not shared with their peers [30].

DATA ENTRY

All of the above data were recorded on prepared data sheets. The original data sheets were then sent to the NNSC. In addition, the nutritionists also recorded the coded data into standardised spreadsheets, which were emailed back to the NNSC.

MEASURING CHILDHOOD OBESITY

BMI is considered to be the best available population marker for monitoring trends in obesity. It is calculated from the formula, weight in kg/height in m^2. Hall [31] has described it simply as an index of weight adjusted for height. Although it has many weaknesses as a measure of fatness of an individual, it is the only convenient measure for monitoring whole population fatness. It is widely used in adult populations and cut-off points of 25 kg/m^2 and 30 kg/m^2 are recognised worldwide as definitions of adult overweight and obesity.



Defining overweight and obesity in children requires a different methodology: Children's body fat content changes as they grow and is different for boys and girls. These differences mean that a single categorisation cannot be used to define childhood overweight and obesity; each sex and age group needs its own categorisation. Age- and sex-specific growth reference percentile charts and corresponding z-scores have been developed for this purpose. Z-scores allow for comparisons of anthropometric measures by standardising the measure relative to a reference population. Different countries however, use different growth reference charts based on different reference populations. This leads to difficulties in comparing data across countries.

In the current study, the British 1990 reference data was used to calculate z-scores [32], because this reference database includes z-scores for weight, height and BMI of 3 to 17-year-old children, separately for boys and girls. The following were computed for each sex: weight-for-age, height-for-age and BMI-for-age z-scores.

To categorise underweight, overweight and obesity categories, Cole et al. in 2000 and 2007 [33, 34] developed a series of age- (by 6-month intervals) and sex-specific BMI cut-off points for the categories of childhood underweight, overweight and obesity based on pooled international data. These BMI cut-off points were derived from sex-specific BMI age curves that pass through a BMI of 18.5, 25 and 30 kg/m^2 at age 18 years (Table 1). These cut-off points correspond to the adult underweight, overweight and obesity cut-off points of 18.5, 25 and 30 kg/m^2, respectively.

TABLE 1 The International Obesity Task Force cut-off points for underweight, overweight and obesity according to body mass index (BMI)

GRADE	*BMI RANGE AT 18 YEARS*
Underweight	**<18.5**
Normal weight	**18.5 - <25**
Overweight	**25 - <30**
Obesity	**≥30**

The percentile cut-off points at age 18 years corresponding to BMI cut-off points for underweight, normal weight, overweight and obesity (Table 1) are used to calculate percentiles and z-scores for children at different ages and sex. This work was done following a recommendation of an expert committee of the International Obesity Task Force (IOTF) and these cut-offs are known as the IOTF cut-off points. They are recommended for use in international comparisons of prevalence of overweight and obesity in childhood populations and therefore used in the current study. Overweight using IOTF cut-off points was defined as overweight including obesity.

Evidence suggests that central adiposity in children is more relevant to health outcomes than overall adiposity estimated by BMI [35, 36]. Furthermore, waist circumference has been advocated as a good indicator of central adiposity [37]. In 2001, McCarthy et al. developed waist circumference percentile curves for British children using 1990 data [38]. Using these data, waist circumference-for-age z-scores were computed. Also, cut-off points were estimated for overweight (including obesity) and obesity, using the 91st and 98th centile, respectively. These centiles were chosen because they are standard on the British charts.

DATA ANALYSIS

Data were anonymised at the point of data entry. The dataset used for analysis included only children with informed consent and complete information on age and sex. Three children were excluded from the waist circumference measurements due to unrealistic waist circumferences (<30 cm) compared to their weight and height.

As outlined by the WHO COSI protocol, only data on the exactly 7-year-olds in First class and 9-year-olds in Third class were analysed for the cross-sectional analysis (Figure 1).

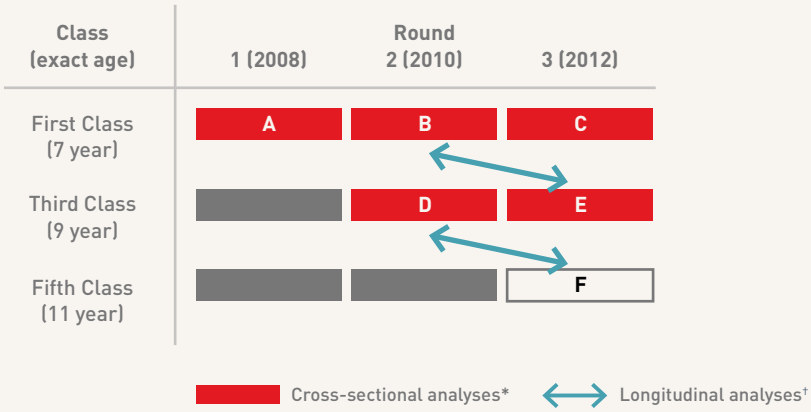


FIGURE 1 Diagram displaying data collection rounds and type of analysis performed as presented in the current report. * Exact ages 7, 9 and 11 years. † All ages in a class.

Cross-sectional analyses involve data collected at one point in time, i.e. Round 1, Round 2 and Round 3 for 7-year-olds (A, B, and C in Figure 1) and Round 2 and Round 3 for 9-year-olds (D and E in Figure 1), respectively. Using a unique identifier longitudinal (cohort) data were also available, in which the same children were measured more than once over the years, i.e. a cohort of children measured once in Round 2 in First class and again two years later when in Third class (B and E in Figure 1) and a second cohort of children measured once in Round 2 in Third class and 2 years later in Fifth class (D and F in Figure 1). For the longitudinal analyses, these were not restricted to 7-year, 9-year and 11-year olds but data on all children in First, Third and Fifth classes were included, in part due to small numbers of children who had longitudinal data but also to maximise the available information.

Children measured in Round 1 (2008) were measured during Spring 2008 (A in Figure 2). For Rounds 2 and 3, measurements were carried out in Autumn and children in Third (D in Figure 2; mean age 9.0 y) and Fifth (F in Figure 2; mean age 11.1 y) class were included, respectively. The children originally measured in 2008 (Round 1) were in fourth (mean age 10.1 y) and sixth (mean age 12.1 y) class in Autumn 2010 (Round 2) and Autumn 2012 (Round 3), respectively (blue line in Figure 2). Therefore, longitudinal data were not available between Round 1 and the other two rounds.

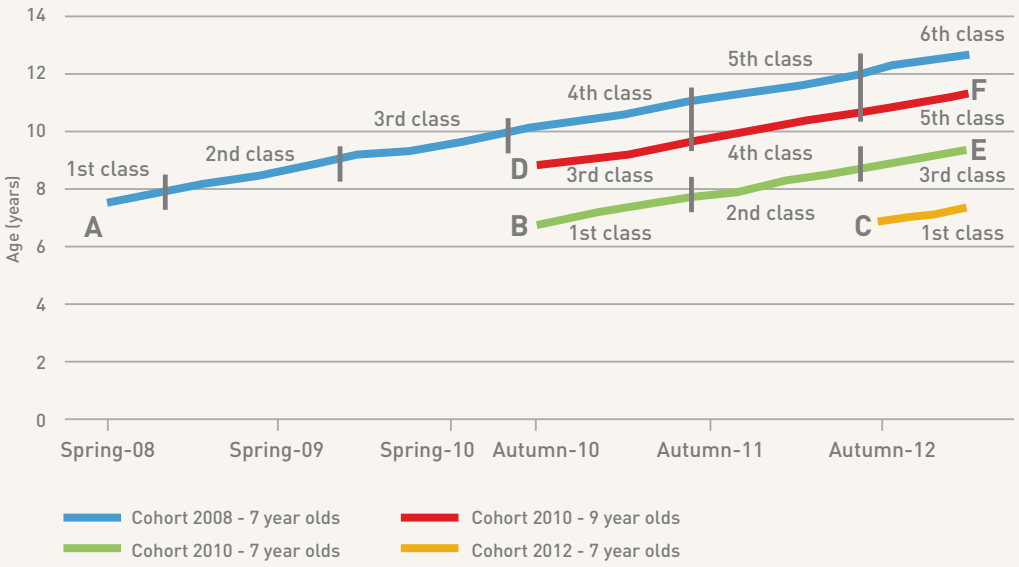


FIGURE 2 Age distributions of each of the four age-cohorts, measured during Round 1 (Spring 2008; point A), Round 2 (Autumn 2010, points B and D) and Round 3 (Autumn 2012, points C, E and F).

When analysing the data, no adjustment for confounding variables were performed except for analyses on actual weight, height, waist circumference and BMI data in 7-year-old children, in which the analyses were adjusted for age. This is because the age-distribution in Round 1 (2008) differs from Rounds 2 (2010) and 3 (2012); Figure 3). In Round 1, age is equally distributed from 7.0 to 8.0 years, but for Rounds 2 and 3, age is only equally distributed from 7.0 until 7.7 years.

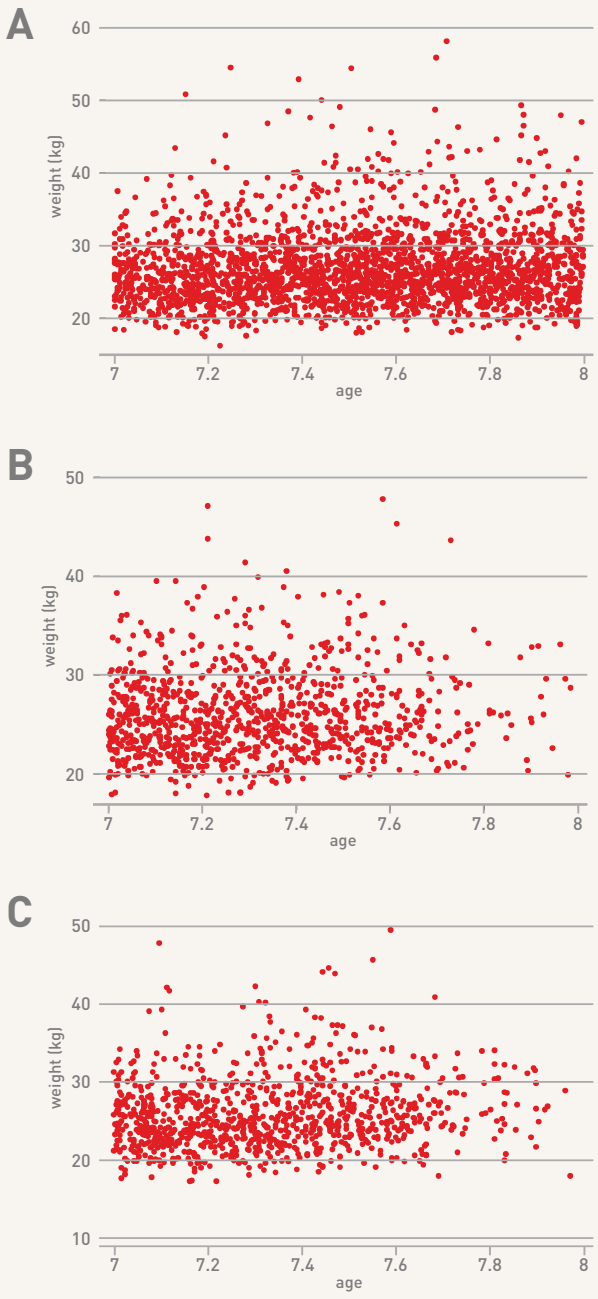


FIGURE 3 Age distribution according to weight measurements for Round 1 (2008; panel A), Round 2 (2010; panel B) and Round 3 (2012, panel C)

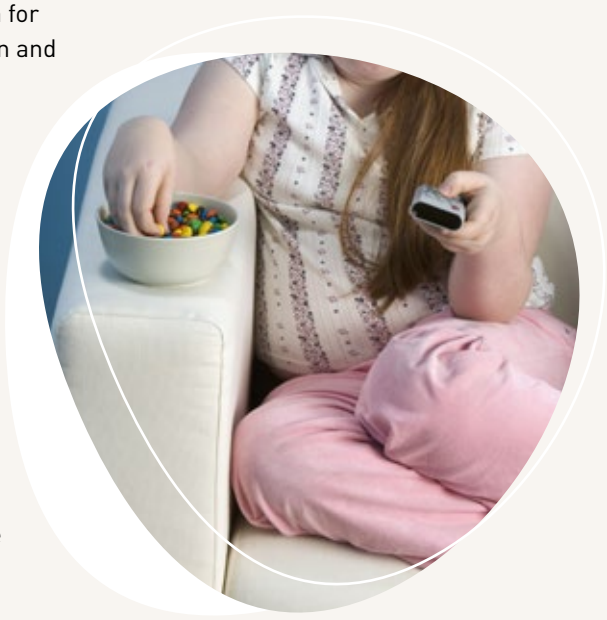
The cross-sectional data were used to present and test for differences between rounds in weight, height, waist circumference and BMI of 7-year and 9-year-old children, respectively (Figures 1 and 2). Analysis of covariance (ANCOVA) was used to assess a linear trend across Round 1 (2008), Round 2 (2010) and Round 3 (2012) in 7-year-old children for weight, height, waist circumference and BMI; including the categorical variable for the rounds as a continuous term in the ANCOVA model adjusted for age as already described. For the 9-year-olds, no trend test could be performed, since there were only two measurements. Hence, an analysis of variance (ANOVA) was used to estimate a difference between Round 2 and Round 3, but now including the variable for the rounds as a categorical term in the model. The cross-sectional data were also used to determine differences and to assess a linear trend in the prevalence of overweight

and obesity across different rounds, using either IOTF cut-off points or cut-off points for waist circumference as defined earlier. To determine a difference, Pearson's chi-squared tests were used. To asses a trend, Pearson's chi-squared tests for trend were used.

As already described, longitudinal data, were available for children measured in First class in 2010 (Round 2) and in Third class in 2012 (Round 3) and for children measured in Third class in 2010 and in Fifth class in 2012 (Figures 1 and 2). These data were used to test for differences over time in weight-for-age, height-for-age, waist circumference-for-age and BMI-for-age z-scores. These analyses were performed using repeated measures ANOVA. Also, data are presented on prevalence of overweight and obesity over time and whether and how children changed over time looking at IOTF categories.

Weight, waist circumference and BMI were found to be highly positively skewed. They were therefore transformed to attain normality and their transformed values were used for the comparisons between rounds. All p-values in this report were based on two-sided tests and considered statistically significant if p-value<0.05. This means that a result is only called statistically significant if the probability of its occurrence purely by chance is less than 5%. However, when multiple tests are performed, the probability of getting a significant result simply due to chance will increase. Throughout this report, no corrections were done for multiple testing, except for the results stratified by HSE region for the cross-sectional analyses in 7-year and 9-year-olds. This is because these two analyses include multiple comparisons between various subgroups in the study. The method used to correct for multiple testing is the Bonferroni Step-down (Holm) correction [39]. No adjustments were done for the cluster-sampling procedure.

In the current report, firstly, study characteristics are described in which school response rates, children's participation rates and age distribution are presented. Secondly, cross-sectional analyses on 7-year and 9-year olds, stratified by sex, are presented. Also, analyses were done stratified by disadvantaged schools and analyses stratified by HSE regions. Disadvantaged schools have been identified by the Department of Education and Skills as those schools that are at a social or economic disadvantage, which prevents students from deriving appropriate benefit from education in schools. The School Support Programme under the DEIS (Delivering Equality of Opportunity in Schools) action plan for educational inclusion, run by the Department of Education and Skills, had identified 631 disadvantaged schools in 2008 and 860 in 2012. The definition of these disadvantaged schools is based upon the "educational disadvantage" in the Education Act (1998) as: "...the impediments to education arising from social or economic disadvantage which prevent students from deriving appropriate benefit from education in schools." [40] The identification of disadvantaged schools for DEIS was based on the following variables: unemployed parents, Local Authority accommodation, lone parenthood, Travellers, free book grants and large families (i.e. ≥4 siblings) [41]. After the cross-sectional analyses, longitudinal analyses are presented and finally, a comparison between COSI data and GUI data are presented.



STUDY CHARACTERISTICS

RECRUITMENT OF SCHOOLS

Letters were sent initially to schools inviting them to participate in the study and these were followed up by telephone calls. In 2008, 163 schools consented to take part in this study. These randomly selected schools were a representative sample of all primary Irish schools taking account of the issue of small schools in the Republic of Ireland [27]. Reasons given for not participating at school level were primarily logistical, e.g. the time frame did not suit the school or they had too many commitments. For further details on the recruitment of schools in 2008, please consult the previous report [27].

In 2010 and 2012, only the schools that took part in 2008 were approached, plus the senior schools if the junior school was included in the 2008 sample (Table 2). Response rates in Rounds 2 and 3 were similar and very high.

TABLE 2 Response rate Rounds 2 and 3

COLLECTION PERIOD		*CLASS*	*RESPONSE RATE*	
Round*	Period		n	%
Round 2	**Oct-Nov 2010**	**First**	**132/163**	**81.0**
		Third	**132/165**	**80.0**
Round 3	**Nov 2012-Jan 2013**	**First**	**136/165**	**82.4**
		Third and Fifth	**133/167**	**79.6**

** From this point onwards referred to as R2 (2010) and R3 (2012), respectively*

In Table 3, response rates according to urban and rural schools are presented for Rounds 2 and 3. The response rates were a little higher in rural schools compared to urban schools.

TABLE 3 Response rate of urban versus rural schools

ROUND	*SCHOOL TYPE*	*RESPONSE RATE URBAN SCHOOLS*		*RESPONSE RATE RURAL SCHOOLS*	
		n	%	n	%
R2 (2010)	**Small Schools**	**31/41**	**75.6**	**25/32**	**78.1**
	Large Schools	**89/107**	**83.2**	**7/8**	**87.5**
R3 (2012)	**Small Schools**	**33/43**	**76.7**	**26/31**	**83.9**
	Large Schools	**92/112**	**82.1**	**8/9**	**88.9**

DISADVANTAGED SCHOOLS

In 2008, 21 disadvantaged schools consented to take part in Round 1. The percentages of disadvantaged schools consenting to participate in Rounds 2 and 3 are comparable (Table 4).

TABLE 4 Response rate of disadvantaged schools

ROUND	SCHOOL TYPE	RESPONSE RATE	
		n	%
R2 (2010)	***Disadvantaged***	**21/25**	**84.0**
	Other schools	**131/162**	**80.9**
R3 (2012)	***Disadvantaged***	**21/27**	**77.8**
	Other schools	**138/168**	**82.1**

PARTICIPATION RATES AND PARENTAL CONSENT

Schools were asked to return a school form, which included data on total class numbers, parents who had not consented for their child to take part in the study, children themselves who declined on the day of measurement and those who were absent. During Round 1 (2008) 154 schools returned a school form, during Round 2 (2010) 154 schools (including junior and senior schools) and during Round 3 (2012) 159 schools (including junior and senior schools). Over the three rounds, data of in total 12,236 examinations are available. Over time, numbers of children in First class being examined decreased, while the percentage of parents who refused for their child in First class to take part increased (Table 5).

TABLE 5 Participation rates and parental consent

ROUND	CLASS	EXAMINED		PARENTS REFUSED		ABSENT	
		n	%	n	%	n	%
R1 (2008)	**First**	**2630/3648**	**72.1**	**806/3648**	**22.1**	**208/3648**	**5.7**
R2 (2010)	**First**	**2013/3134**	**64.2**	**1000/3134**	**31.9**	**113/3134**	**3.6**
	Third	**2016/3159**	**63.8**	**1028/3159**	**32.5**	**114/3159**	**3.6**
R3 (2012)	**First**	**1729/3156**	**54.8**	**1238/3156**	**39.2**	**189/3156**	**6.0**
	Third	**1945/3114**	**62.5**	**1004/3114**	**32.2**	**165/3114**	**5.3**
	Fifth	**1903/3117**	**61.1**	**1023/3117**	**32.8**	**188/3117**	**6.0**

For children in Third class, the percentages were similar for Rounds 2 and Round 3. Children being absent on the day of the measurement ranged from 3.6% for Third class students in 2010 to 6.0% for First and Fifth class students in 2012. Only a very small number (4, 9, and 3) of children declined to take part themselves on the day of the measurement during Round 1, Round 2 and Round 3, respectively.

PROFILE OF PARTICIPANTS

The age distribution of all the children measured in the three rounds is shown in Table 6. As outlined by the WHO COSI protocol only the data on those exactly 7 years old and exactly 9 years old were analysed for the cross-sectional analyses. In the longitudinal analyses, all children in First, Third and Fifth classes who were measured on two consecutive occasions, were included in these analyses. Further information on the children whose data were not analysed in the current report, is shown in Appendix 1.

TABLE 6 Age distribution of boys and girls in the study (with the target age groups highlighted)

CLASS	AGE	R1 (2008)				R2 (2010)				R3 (2012)			
		Boys		Girls		Boys		Girls		Boys		Girls	
		n	%	n	%	n	%	n	%	n	%	n	%
First	**5**	**1**	**0.08**	**0**	**0**	**4**	**0.4**	**9**	**0.9**	**2**	**0.2**	**4**	**0.5**
	6	**29**	**2.3**	**32**	**2.3**	**440**	**44.5**	**552**	**53.5**	**342**	**40.1**	**371**	**42.6**
	7	**1129**	**90.1**	**1286**	**93.0**	**533**	**54.0**	**463**	**44.9**	**501**	**58.7**	**490**	**56.2**
	8	**94**	**7.5**	**65**	**4.7**	**11**	**1.1**	**8**	**0.8**	**9**	**1.1**	**7**	**0.8**
	Totals	**1253**		**1383**		**988**		**1032**		**854**		**872**	
Third	**7**					**8**	**0.9**	**7**	**0.7**	**4**	**0.4**	**7**	**0.7**
	8					**421**	**44.9**	**566**	**53.0**	**326**	**35.9**	**482**	**46.4**
	9					**503**	**53.6**	**482**	**45.1**	**564**	**62.2**	**537**	**51.7**
	10					**6**	**0.6**	**13**	**1.2**	**13**	**1.4**	**12**	**1.2**
	Totals					**938**		**1068**		**907**		**1038**	
Fifth	**9**									**4**	**0.4**	**6**	**0.6**
	10									**337**	**37.4**	**451**	**45.2**
	11									**543**	**60.2**	**533**	**53.4**
	12									**18**	**2.0**	**8**	**0.8**
	Totals									**902**		**998**	

RESULTS OF CROSS-SECTIONAL ANALYSES

OVERALL GROUP

The results of the cross-sectional comparison of anthropometric data for 7-year and 9-year-old children are shown in Tables 7 and 8, respectively.

TABLE 7 Differences over time in weight, height, waist circumference and body mass index (BMI) for 7-year-old boys and girls in First class

ANTHROPOMETRIC MEASURE	GENDER	ROUND	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Weight (kg)	**Boys**	**R1 (2008)**	**1126**	**26.2**	**24.0-29.1**	**16.2**	**54.4**
		R2 (2010)	**532**	**25.5**	**23.3-28.3**	**18.0**	**45.3**
		R3 (2012)	**500**	**25.3**	**23.1-28.3**	**17.3**	**49.5**
		p-value*		**0.005**			
	Girls	**R1 (2008)**	**1286**	**25.6**	**23.1-29.1**	**17.3**	**58.1**
		R2 (2010)	**461**	**25.1**	**22.5-28.0**	**17.8**	**47.8**
		R3 (2012)	**490**	**24.8**	**22.3-28.1**	**17.3**	**45.7**
		p-value*		**0.007**			
Height (cm)	**Boys**	**R1 (2008)**	**1125**	**126.5**	**122.9-130.1**	**109.9**	**150.6**
		R2 (2010)	**532**	**125.3**	**121.9-129.2**	**110.9**	**145.3**
		R3 (2012)	**501**	**125.4**	**121.6-129.3**	**109.8**	**145.2**
		p-value*		**0.114**			
	Girls	**R1 (2008)**	**1286**	**124.8**	**121.0-128.6**	**106.5**	**144.1**
		R2 (2010)	**460**	**123.4**	**120.0-127.5**	**110.1**	**139.2**
		R3 (2012)	**490**	**124.1**	**120.3-127.3**	**108.9**	**140.8**
		p-value*		**0.094**			
Waist (cm)	**Boys**	**R1 (2008)**	**1124**	**57.3**	**55.0-60.1**	**46.0**	**87.2**
		R2 (2010)	**532**	**56.6**	**54.1-59.7**	**47.2**	**87.3**
		R3 (2012)	**501**	**55.5**	**53.1-59.0**	**47.1**	**84.3**
		p-value*		**<0.001**			
	Girls	**R1 (2008)**	**1285**	**56.8**	**53.9-61.2**	**45.9**	**91.9**
		R2 (2010)	**460**	**56.7**	**53.2-60.9**	**46.0**	**80.1**
		R3 (2012)	**490**	**56.2**	**52.7-59.8**	**45.1**	**88.6**
		p-value*		**0.002**			
BMI (kg/m^2)	**Boys**	**R1 (2008)**	**1125**	**16.4**	**15.5-17.6**	**11.9**	**27.8**
		R2 (2010)	**532**	**16.2**	**15.4-17.3**	**13.4**	**27.0**
		R3 (2012)	**500**	**16.2**	**15.1-17.2**	**12.3**	**26.1**
		p-value*		**0.008**			
	Girls	**R1 (2008)**	**1286**	**16.4**	**15.5-18.1**	**12.6**	**31.8**
		R2 (2010)	**460**	**16.4**	**15.3-17.9**	**12.7**	**26.0**
		R3 (2012)	**490**	**16.3**	**15.2-17.7**	**12.3**	**26.1**
		p-value*		**0.015**			

** P-value for trend, adjusted for age*

Small but statistically significant inverse trends over time were observed for weight, waist circumference and BMI in both 7-year-old boys and girls in First class (after adjustment for age; Table 7). No significant trends were observed for height however.

TABLE 8 Differences over time in weight, height, waist circumference and body mass index (BMI) for 9-year-old boys and girls in Third class

ANTHROPOMETRIC MEASURE	GENDER	ROUND	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Weight (kg)	**Boys**	**R2 (2010)**	**503**	**32.0**	**28.4-36.4**	**20.7**	**63.1**
		R3 (2012)	**564**	**31.9**	**28.4-36.3**	**21.9**	**69.1**
		p-value		**0.939**			
	Girls	**R2 (2010)**	**482**	**31.3**	**27.3-36.2**	**20.2**	**61.4**
		R3 (2012)	**537**	**31.4**	**28.0-35.5**	**21.5**	**60.0**
		p-value		**0.487**			
Height (cm)	**Boys**	**R2 (2010)**	**503**	**136.4**	**132.5-140.1**	**121.5**	**153.1**
		R3 (2012)	**564**	**136.7**	**132.3-140.6**	**114.7**	**155.4**
		p-value		**0.968**			
	Girls	**R2 (2010)**	**482**	**135.0**	**130.7-139.6**	**117.1**	**153.9**
		R3 (2012)	**537**	**135.3**	**131.3-139.4**	**118.5**	**152.2**
		p-value		**0.554**			
Waist (cm)	**Boys**	**R2 (2010)**	**503**	**60.8**	**57.0-65.4**	**48.5**	**92.2**
		R3 (2012)	**564**	**60.1**	**56.9-64.9**	**39.2**	**99.9**
		p-value		**0.259**			
	Girls	**R2 (2010)**	**481**	**59.6**	**56.0-65.4**	**49.4**	**89.3**
		R3 (2012)	**536**	**59.4**	**55.3-64.5**	**42.5**	**98.6**
		p-value		**0.080**			
BMI (kg/m²)	**Boys**	**R2 (2010)**	**503**	**17.2**	**16.0-18.7**	**13.2**	**27.7**
		R3 (2012)	**564**	**17.1**	**16.0-18.8**	**13.0**	**31.0**
		p-value		**0.814**			
	Girls	**R2 (2010)**	**482**	**17.2**	**15.7-19.1**	**11.8**	**31.3**
		R3 (2012)	**537**	**17.1**	**15.8-19.0**	**12.9**	**29.6**
		p-value		**0.655**			

In contrast, for the 9-year-old boys and girls, no significant differences were observed between Round 2 and Round 3 for any of the variables weight, height, waist circumference or BMI (Table 8).

DIFFERENCES BETWEEN BOYS AND GIRLS

Between boys and girls aged 7 in First class, significant differences for height were observed consistently in all rounds (p-value<0.001 after adjustment for age), with boys being taller than girls. Also, a significant difference was observed between boys and girls for weight in Round 1 (2008; p-value=0.013 after adjustment for age), but no differences were observed in the other two rounds (p-value=0.075 and 0.234 for Round 2 [2010] and 3 [2012], respectively). No differences were observed between boys and girls aged 7 for BMI and waist circumference.

Between boys and girls aged 9 in Third class, significant differences were again observed for height in both Rounds 2 and 3 (p-value<0.01), with boys being taller than girls. A significant difference was observed between boys and girls for weight in Round 2 (2010; p-value=0.018), but no differences were observed in Round 3 (2012). Furthermore, a significant difference was observed for Round 3 for waist circumference (p-value=0.012), but not for Round 2. No differences were observed between boys and girls aged 9 for BMI.

Figures 4 and 5 present overweight (including obesity) and obesity prevalence using IOTF cut-off points for the different rounds in 7-year and 9-year-old children, respectively.

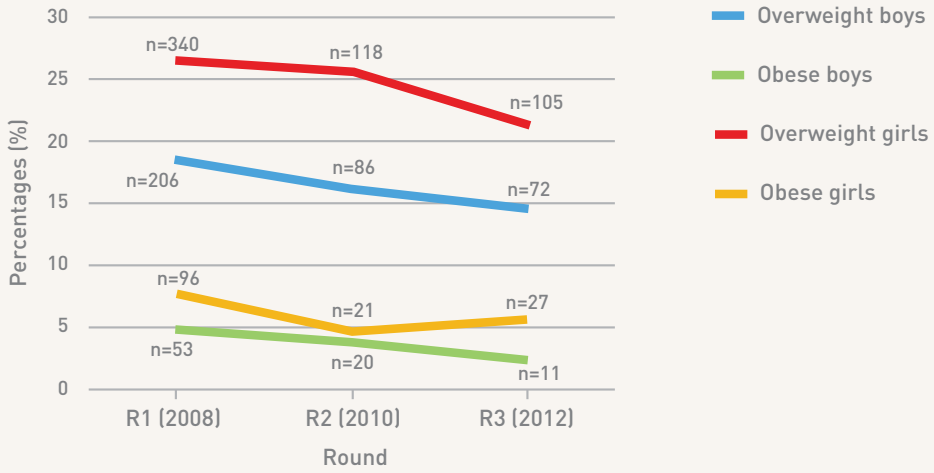


FIGURE 4 Differences over time in overweight (including obesity) and obesity prevalence (categorised using IOTF standards) for 7-year-old boys and girls in First class

A significant inverse trend in both boys and girls aged 7 in First class was observed for overweight (p-value for trend=0.045 for boys and 0.039 for girls; Figure 4). For obesity, a significant inverse trend was observed in boys (p-value for trend=0.018). No significant trend was observed in girls, although there was a tendency for an inverse trend (p-value for trend=0.063; Figure 4)

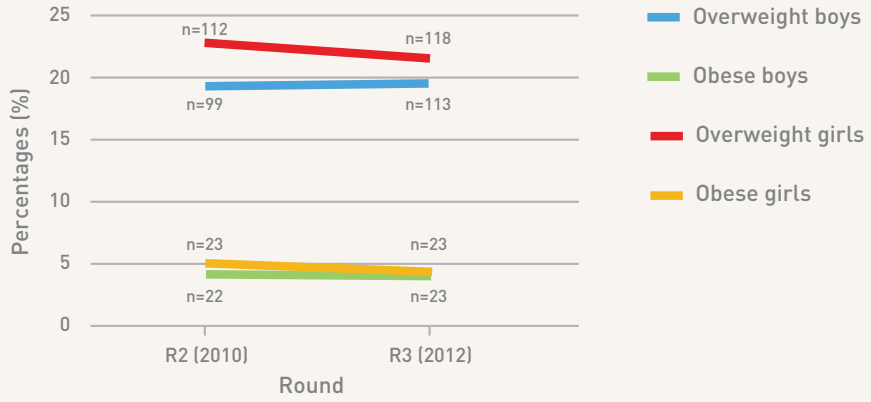


FIGURE 5 Differences over time in overweight (including obesity) and obesity prevalence (categorised using IOTF standards) for 9-year-old boys and girls in Third class

For 9-year-old boys and girls in Third class (Figure 5), no significant differences were observed for overweight and obesity among boys and girls.

As indicated in the methods section, central adiposity in children might be more relevant to health outcomes than overall adiposity estimated by BMI. Therefore, cut-off points for waist circumference using British Standards Institute survey reference data were investigated next. The prevalence of overweight (including obesity) and obesity are somewhat higher compared to the prevalence using IOTF cut-off points (Figures 6 and 7).

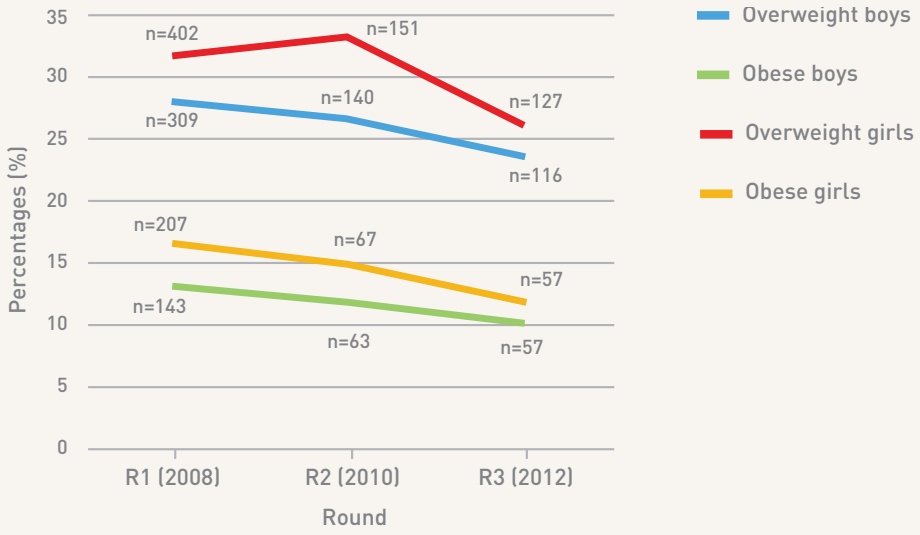


FIGURE 6 Differences over time in overweight (including obesity) and obesity prevalence (categorised using reference data for waist circumference from the British Standards Institute survey) for 7-year-old boys and girls in First class

For boys and girls aged 7 in First class, no significant trend was observed, although there was a tendency for an inverse trend (p-value for trend=0.075 for boys and 0.063 for girls; Figure 6). For obesity, a significant inverse trend was observed in girls, but not in boys (p-value for trend=0.122 for boys and 0.019 for girls; Figure 6).

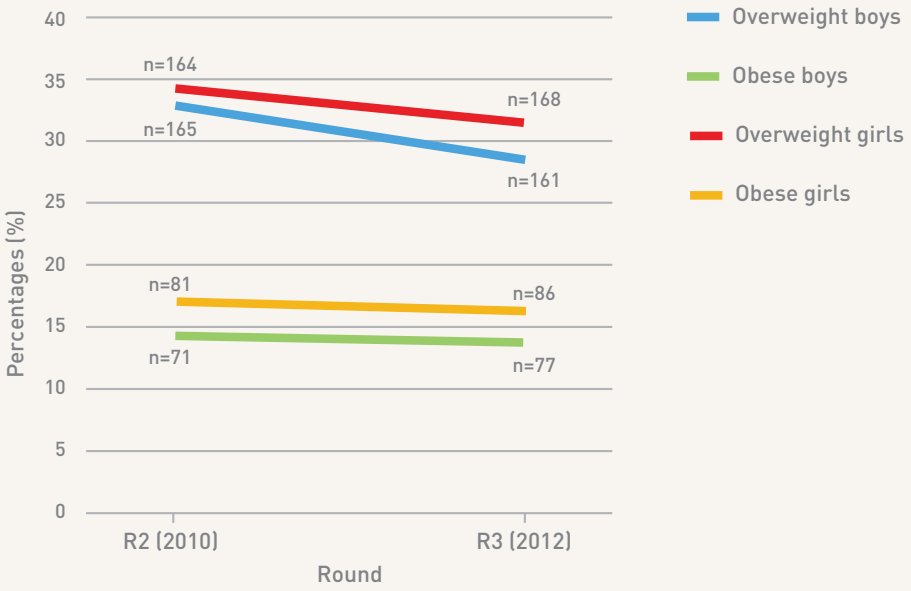


FIGURE 7 Differences over time in overweight (including obesity) and obesity prevalence (categorised using reference data for waist circumference from the British Standards Institute survey) for 9-year-old boys and girls in Third class

We observed no significant differences in prevalence for overweight and obesity among boys and girls aged 9 who were in Third class (Figure 7).

DISADVANTAGED SCHOOLS

In Tables 9 and 10, data are presented stratified by disadvantaged (as defined earlier) schools for 7-year and 9-year-old children, respectively.

TABLE 9 Comparisons of prevalence of overweight (including obesity) and obesity (using IOTF standards) by disadvantaged schools for all First class boys and girls combined

ROUND	SCHOOL TYPE					
	DISADVANTAGED			OTHER SCHOOLS		
Prevalence of overweight (including obesity)						
	Total n (boys/girls)	%	n	Total n (boys/girls)	%	n
R1 (2008)	**126/145**	**26.6**	**72**	**1125/1238**	**22.4**	**529**
R2 (2010)	**96/54**	**24.0**	**36**	**889/977**	**21.9**	**408**
R3 (2012)	**91/77**	**25.0**	**42**	**764/795**	**17.8**	**277**
p-value*		**0.935**			**0.001**	
Prevalence of obesity						
	Total n (boys/girls)	%	n	Total n (boys/girls)	%	n
R1 (2008)	**126/145**	**10.7**	**29**	**1125/1238**	**5.8**	**136**
R2 (2010)	**96/54**	**10.7**	**16**	**889/977**	**4.6**	**85**
R3 (2012)	**91/77**	**8.3**	**14**	**764/795**	**4.2**	**65**
p-value*		**0.607**			**0.022**	

** P-value for trend*

For First class pupils, significant inverse trends for overweight (including obesity) and obesity in the other schools (Table 9) were observed. No such trends were observed for disadvantaged schools, with prevalence of overweight and obesity remaining similar over time. This shows a clear difference between the two school types.

TABLE 10 Comparisons of prevalence of overweight (including obesity) and obesity (using IOTF standards) by disadvantaged schools for all Third class boys and girls combined

ROUND	SCHOOL TYPE					
	DISADVANTAGED			OTHER SCHOOLS		
Prevalence of overweight (including obesity)						
	Total n (boys/girls)	%	n	Total n (boys/girls)	%	n
R2 (2010)	**108/79**	**29.4**	**55**	**829/989**	**24.0**	**436**
R3 (2012)	**88/93**	**27.6**	**50**	**819/947**	**21.5**	**379**
p-value		**0.611**			**0.074**	
Prevalence of obesity						
	Total n (boys/girls)	%	n	Total n (boys/girls)	%	n
R2 (2010)	**108/79**	**12.8**	**24**	**829/989**	**6.0**	**108**
R3 (2012)	**88/93**	**7.2**	**13**	**819/947**	**4.6**	**81**
p-value		**0.075**			**0.072**	

For Third class pupils, no statistically significant differences between Rounds 2 and 3 in disadvantaged or other schools were observed (Table 10), though a borderline significant difference between rounds was observed for other schools and in disadvantaged schools for prevalence of obesity.

HSE REGIONS

In Tables 11 and 12, data are presented stratified by HSE region for 7-year and 9-year-old children, respectively.

TABLE 11 Comparisons of prevalence of overweight (including obesity) and obesity (using IOTF standards) by Health Service Executive (HSE) region for 7-year-old boys and girls in First class

HSE REGION	ROUND	TOTAL N (BOYS/GIRLS)	PREVALENCE OF OVERWEIGHT (INCLUDING OBESITY)†				PREVALENCE OF OBESITY**			
			Boys		Girls		Boys		Girls	
			%	n	%	n	%	n	%	n
South	**R1 (2008)**	**250/308**	**18.0**	**45**	**25.7**	**79**	**4.4**	**11**	**6.8**	**21**
	R2 (2010)	**138/135**	**13.0**	**18**	**23.0**	**31**	**6.5**	**9**	**3.0**	**4**
	R3 (2012)	**122/111**	**14.8**	**18**	**16.2**	**18**	**4.1**	**5**	**1.8**	**2**
	p-value*		**1.000**		**0.700**		**0.945**		**0.416**	
Dublin North-East	**R1 (2008)**	**267/296**	**18.0**	**48**	**25.3**	**75**	**3.0**	**8**	**5.4**	**16**
	R2 (2010)	**130/107**	**22.3**	**29**	**25.2**	**27**	**1.5**	**2**	**2.8**	**3**
	R3 (2012)	**119/131**	**12.6**	**15**	**19.1**	**25**	**1.7**	**2**	**6.9**	**9**
	p-value*		**1.000**		**1.000**		**1.000**		**1.000**	
Dublin Mid-Leinster	**R1 (2008)**	**345/359**	**17.1**	**59**	**26.7**	**96**	**4.9**	**17**	**9.5**	**34**
	R2 (2010)	**172/138**	**15.7**	**27**	**23.2**	**32**	**4.1**	**7**	**5.1**	**7**
	R3 (2012)	**137/138**	**13.1**	**18**	**24.6**	**34**	**0.7**	**1**	**5.1**	**7**
	p-value*		**1.000**		**1.000**		**0.705**		**0.793**	
West	**R1 (2008)**	**263/323**	**20.5**	**54**	**27.9**	**90**	**6.5**	**17**	**7.7**	**25**
	R2 (2010)	**92/80**	**13.0**	**12**	**35.0**	**28**	**2.2**	**2**	**8.8**	**7**
	R3 (2012)	**122/110**	**17.2**	**21**	**25.5**	**28**	**2.5**	**3**	**8.2**	**9**
	p-value*		**1.000**		**1.000**		**0.756**		**1.000**	

** P-value for trend corrected for multiple testing using the Bonferroni Step-down (Holm) correction; † Prevalence of overweight (including obesity) among all 7-year-old boys in First class: 18.3%, 16.2% and 14.4% for R1 (2008), R2 (2010) and R3 (2012), respectively. Prevalence of overweight (including obesity) among all 7-year-old girls in First class: 26.4%, 25.7% and 21.4% for R1 (2008), R2 (2010) and R3 (2012), respectively; ** Prevalence of obesity among all 7-year-old boys in First class: 4.7%, 3.8% and 2.2% for R1 (2008), R2 (2010) and R3 (2012), respectively. Prevalence of obesity among all 7-year-old girls in First class: 7.5%, 4.6% and 5.5% for R1 (2008), R2 (2010) and R3 (2012), respectively.*

After correction for multiple testing, no significant differences were observed between the different rounds in prevalence of overweight (including obesity) and obesity for the different HSE regions in boys and girls in First class aged 7 (Table 11).

TABLE 12 Comparisons of prevalence of overweight (including obesity) and obesity (using IOTF standards) by Health Service Executive (HSE) region for 9-year-old boys and girls in Third class

HSE REGION	ROUND	TOTAL N (BOYS/GIRLS)	PREVALENCE OF OVERWEIGHT (INCLUDING OBESITY)†				PREVALENCE OF OBESITY**			
			Boys		Girls		Boys		Girls	
			%	n	%	n	%	n	%	n
South	**R2 (2010)**	**143/129**	**17.5**	**25**	**20.9**	**27**	**2.1**	**3**	**4.7**	**6**
	R3 (2012)	**126/139**	**16.7**	**21**	**22.3**	**31**	**4.8**	**6**	**3.6**	**5**
	p-value*		**1.000**		**1.000**		**1.000**		**1.000**	
Dublin North-East	**R2 (2010)**	**127/131**	**15.0**	**19**	**26.7**	**35**	**3.9**	**5**	**6.1**	**8**
	R3 (2012)	**152/143**	**19.7**	**30**	**25.9**	**37**	**6.6**	**10**	**4.2**	**6**
	p-value*		**1.000**		**1.000**		**1.000**		**1.000**	
Dublin Mid-Leinster	**R2 (2010)**	**158/128**	**20.3**	**32**	**21.9**	**28**	**5.1**	**8**	**5.5**	**7**
	R3 (2012)	**154/154**	**22.1**	**34**	**17.5**	**27**	**2.6**	**4**	**3.9**	**6**
	p-value*		**1.000**		**1.000**		**1.000**		**1.000**	
West	**R2 (2010)**	**75/94**	**30.7**	**23**	**23.4**	**22**	**8.0**	**6**	**2.1**	**2**
	R3 (2012)	**132/101**	**21.2**	**28**	**22.8**	**23**	**2.3**	**3**	**5.9**	**6**
	p-value*		**1.000**		**0.917**		**0.832**		**1.000**	

** Corrected for multiple testing using the Bonferroni Step-down (Holm) correction † Prevalence of overweight (including obesity) among all 9-year-old boys in First class: 27.5%, 26.3% and 23.2% for R1 (2008), R2 (2010) and R3 (2012), respectively. Prevalence of overweight (including obesity) among all 9-year-old girls in First class: 31.3%, 32.8% and 25.9% for R1 (2008), R2 (2010) and R3 (2012), respectively; ** Prevalence of obesity among all 9-year-old boys in First class: 12.7%, 11.8% and 10.0% for R1 (2008), R2 (2010) and R3 (2012), respectively. Prevalence of obesity among all 9-year-old girls in First class: 16.1%, 14.6% and 11.6% for R1 (2008), R2 (2010) and R3 (2012), respectively.*

Also for 9-year-old boys and girls in Third class, no differences in prevalence of overweight and obesity were observed for the different HSE regions (Table 12).

RESULTS OF LONGITUDINAL ANALYSES

OVERALL GROUP

Panels A and C in Figures 8 and 9, present changes in weight-for-age, height-for-age, waist circumference-for-age and BMI-for-age z-scores for boys and girls who were in First class in 2010 (Round 2) and in Third class in 2012 (Round 3), respectively. Panels B and D in Figures 8 and 9, present changes for boys and girls who were in Third class in 2010 and in Fifth class in 2012, respectively.

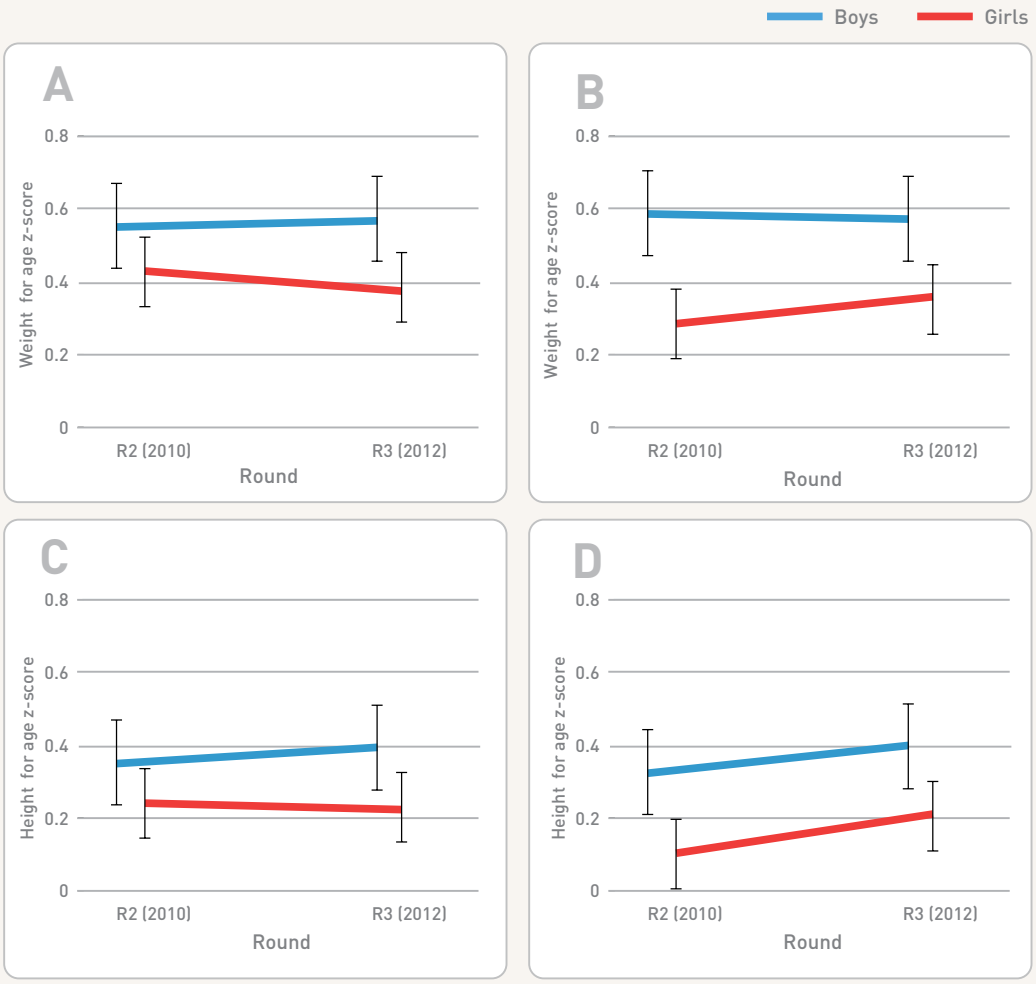


FIGURE 8 Change in weight (panel A; 296 boys and 374 girls) and height (panel C; 296 boys and 373 girls) z-scores for boys and girls who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3) and change in weight (panel B; 342 boys and 400 girls) and height (panel D; 342 boys and 402 girls) z-scores for boys and girls who were in Third class in 2010 (median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012.

Weight did not change over time for boys after adjustment for age. But weight significantly decreased for girls who were in First class in 2010 and in Third class in 2012 (p=0.013; Figure 8, panel A) and significantly increased for girls who were in Third class in 2010 and in Fifth class in 2012 (p=0.004; Figure 8, panel B). Regarding height, no significant changes were observed for children who were in First class in 2010 and in Third class in 2012 (Figure 8, panel C). For children who were in Third class in 2010 and in Fifth class in 2012, height significantly increased over time, after adjustment for age (p=0.0013 for boys and p<0.001 for girls, Figure 8, panel D). This finding could be explained by children having a 'growth spurt' at the time of puberty.

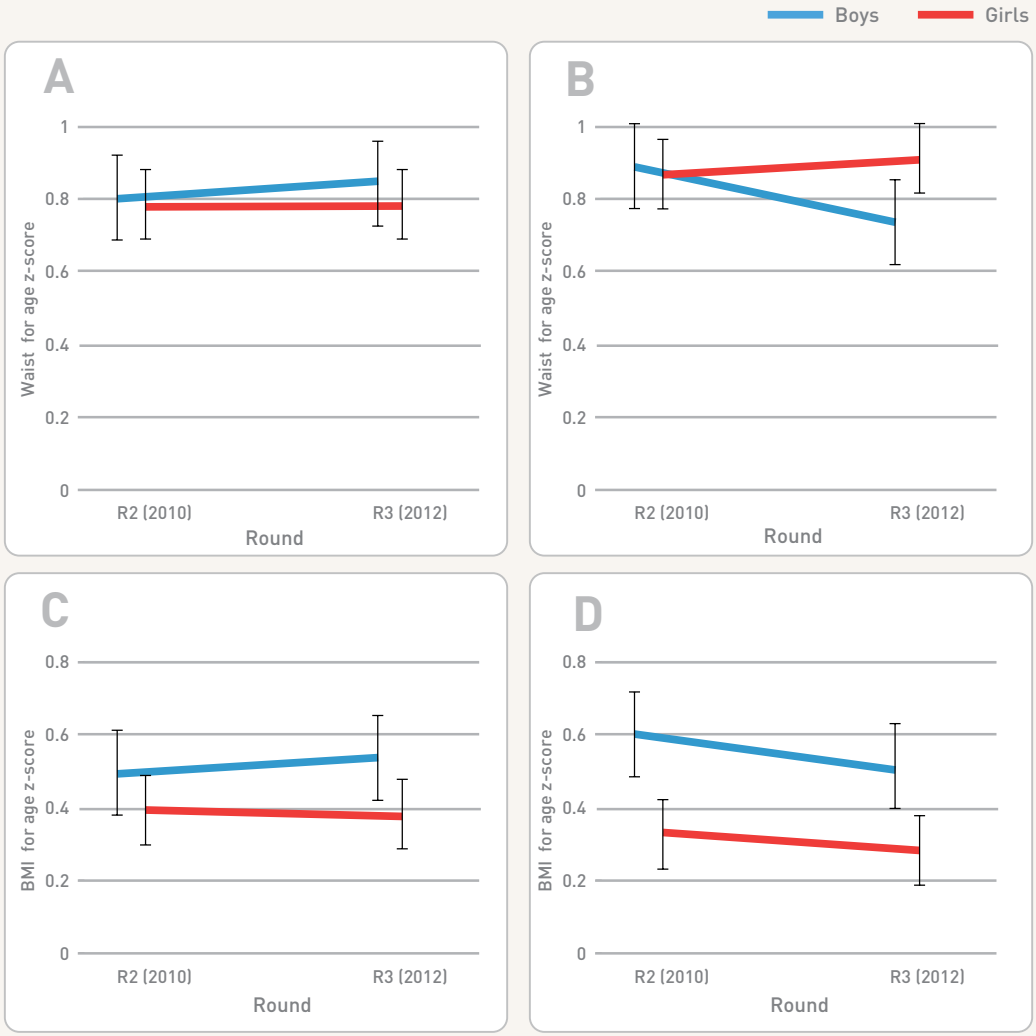


FIGURE 9 Change in waist circumference (panel A; 296 boys and 372 girls) and body mass index (BMI; panel C; 296 boys and 373 girls) z-scores for boys and girls who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3) and change in waist circumference (panel B; 341 boys and 401 girls) and BMI (panel D; 342 boys and 400 girls) z-scores for boys and girls who were in Third class in 2010 (median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012.

Waist circumference significantly decreased over time for boys who were in Third class in 2010 and in Fifth class in 2012 ($p<0.001$; Figure 9, panel B). No differences were observed for girls and for younger boys (Figure 9, panels A and B). BMI significantly decreased over time for boys who were in Third class in 2010 and in Fifth class in 2012 ($p=0.004$; Figure 9, panel D). Again, no differences were observed for girls and for younger boys (Figure 9, panels C and D).

Figure 10 shows the prevalence of overweight (excluding obesity) and obesity (using IOTF standards) of boys (panel A) and girls (panel B) who were in First class in 2010 (Round 2; yellow bars) and in Third class in 2012 (Round 3; red bars).

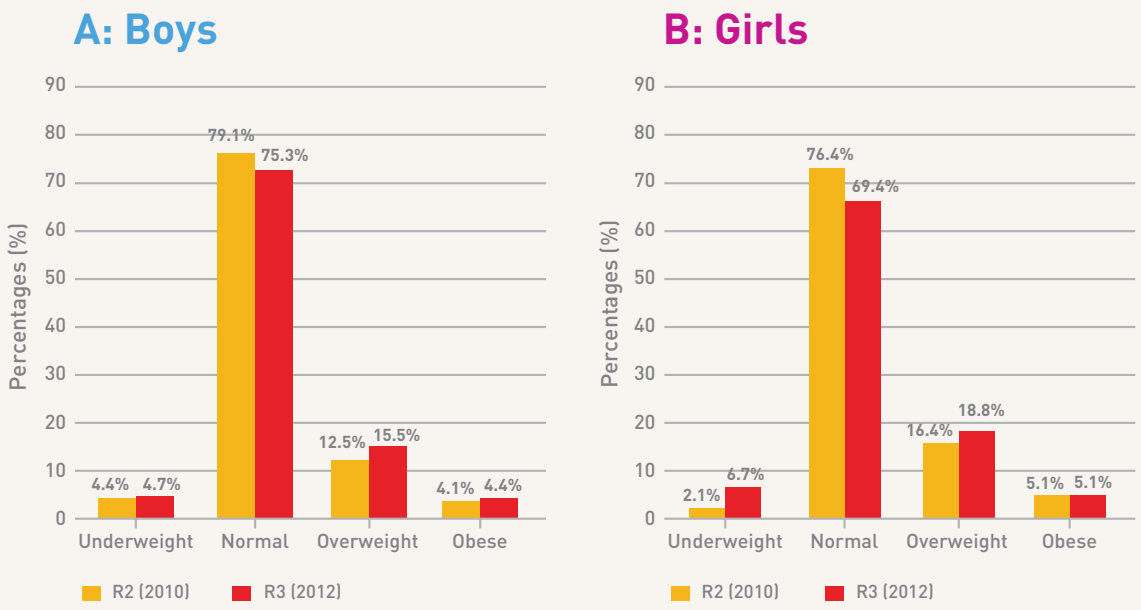


FIGURE 10 Longitudinal comparison of overweight and obesity prevalence (categorised using IOTF standards) over time for boys (panel A; n=296) and girls (panel B; n=373) who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3).

Prevalence of overweight and obesity were relatively similar over time for both boys and girls who were in First class in 2010 and in Third class in 2012 (Figure 10).

Prevalence of overweight (excluding obesity) and obesity using waist data (categorised with reference data from British Standards Insitute survey) of boys and girls who where in First class in 2010 (yellow bars) and in Third class in 2012 (red bars) are shown in Figure 11 (panel A: boys, panel B: girls).

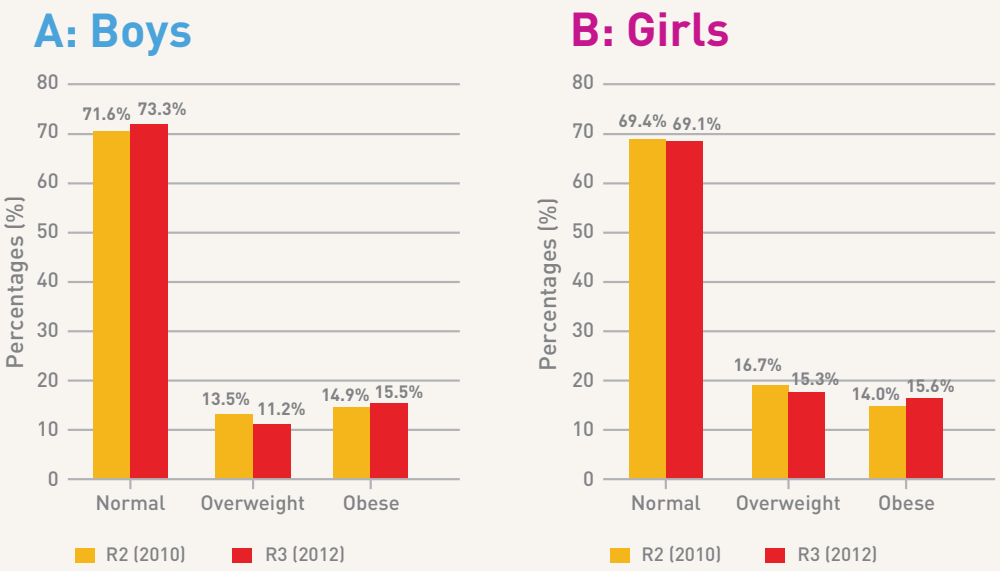


FIGURE 11 Longitudinal comparison of overweight and obesity prevalence (categorised using reference data for waist circumference from the British Standards Institute survey) over time for boys (panel A; n=296) and girls (panel B; n=372) who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3)

Prevalence of overweight and obesity using cut-off values for waist circumference were relatively similar over time for both boys and girls who were in First class in 2010 and in Third class in 2012 (Figure 11).

Figure 12 show the prevalence of overweight (excluding obesity) and obesity (using IOTF standards) of boys (panel A) and girls (panel B), respectively, who were in Third class in 2010 (yellow bars) and in Fifth class in 2012 (red bars).

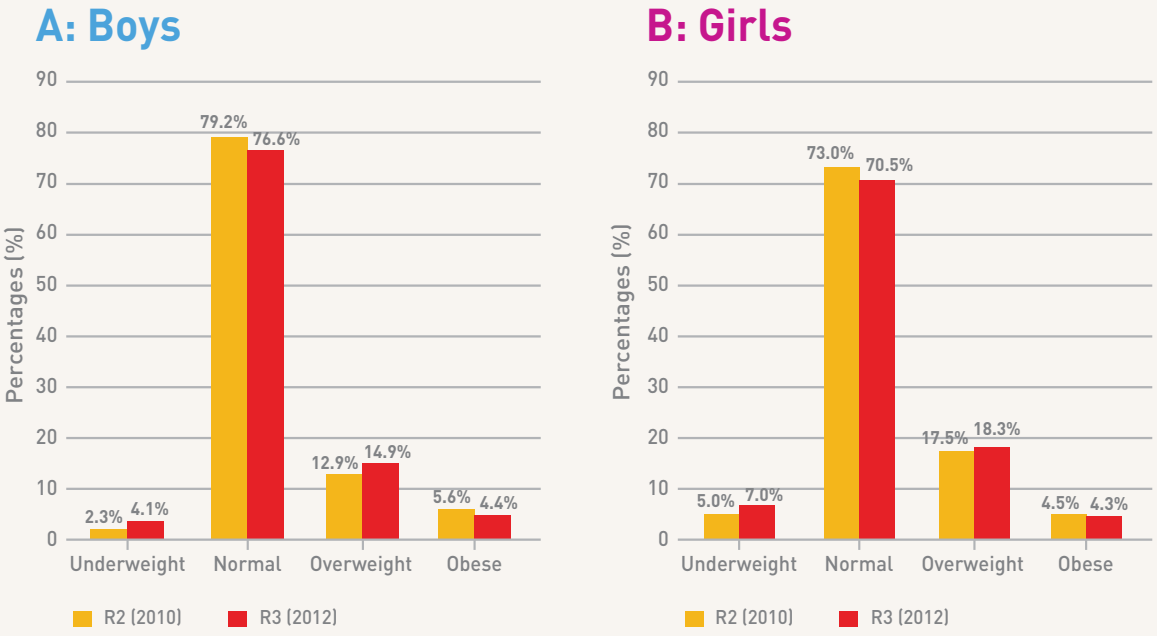


FIGURE 12 Longitudinal comparison of overweight and obesity prevalence (categorised using IOTF standards) over time for boys (panel A; n=342) and girls (panel B; n=400) who were in Third class in 2010 (R2; median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012 (R3).

Again, prevalences of overweight and obesity (using IOTF standards) were relatively similar over time for both boys and girls who were in Third class in 2010 and in Fifth class in 2012 (Figure 12).

Prevalence of overweight (excluding obesity) and obesity using waist data (categorised with reference data from British Standards Insitute survey) of boys and girls who where in Third class in 2010 (yellow bars) and in Fifth class in 2012 (red bars) are shown in Figure 13 (panel A: boys, panel B: girls).

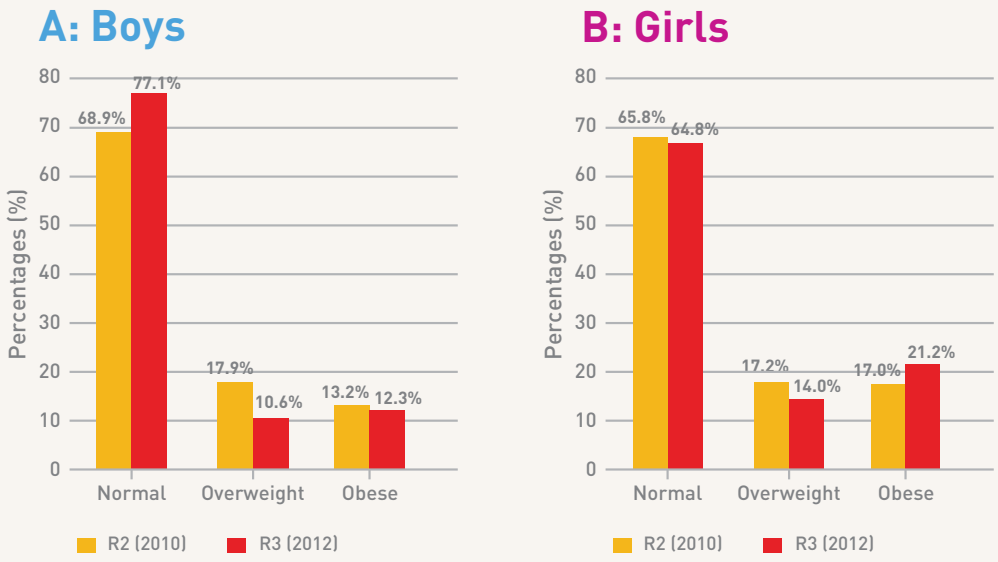


FIGURE 13 Longitudinal comparison of overweight and obesity prevalence (categorised using reference data for waist circumference from the British Standards Institute survey) over time for boys (panel A; n=341) and girls (panel B; n=401) who were in Third class in 2010 (R2; median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012 (R3).

Prevalences of overweight and obesity using waist data (categorised with reference data from British Standards Insitute survey) were relatively similar as well over time for both boys and girls who were in Third class in 2010 and in Fifth class in 2012 (Figure 13).

Figure 14 shows the change in IOTF categories over time for boys (panel A) and girls (panel B) who were in First class in 2010 and in Third class in 2012.

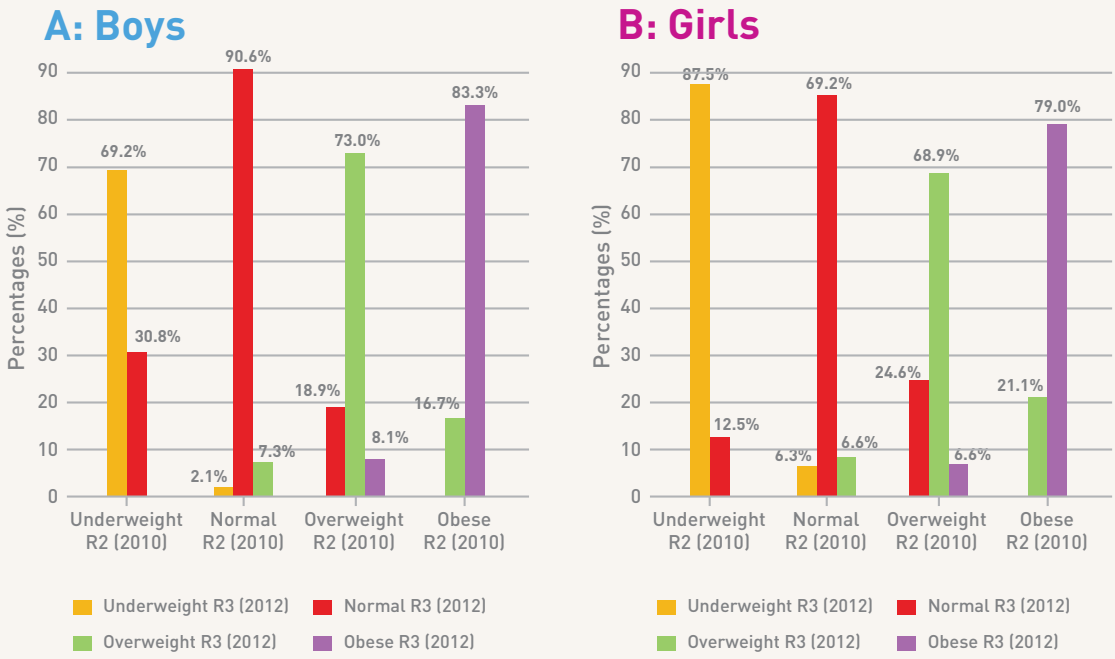


FIGURE 14 Longitudinal change in body mass index categorization using IOTF cut-off points for boys (panel A) and girls (panel B) who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3). Underweight: 13 boys, 8 girls; normal weight: 234 boys, 265 girls; overweight (excluding obesity): 37 boys, 61 girls; obese: 12 boys, 19 girls.

Approximately one third of the boys (left of panel A, Figure 14) who were underweight in First class in 2010 (Round 2), were normal weight when in Fifth class in 2012 (Round 3; n=4). Among the girls who were underweight in 2010, only 1 girl had a normal weight in 2012 (left of panel B, Figure 14). The majority of First class boys and girls who had a normal BMI in 2010, still had a normal BMI in 2012. For overweight children in 2010, one fifth of the boys and one fourth of the girls became normal weight in 2012. Approximately 70% remained overweight. The majority of obese boys and girls in 2010 were still obese in 2012 (right of panel A and B, respectively).

Figure 15 shows the change in IOTF categories over time for boys (panel A) and girls (panel B) who were in Third class in 2010 and in Fifth class in 2012.

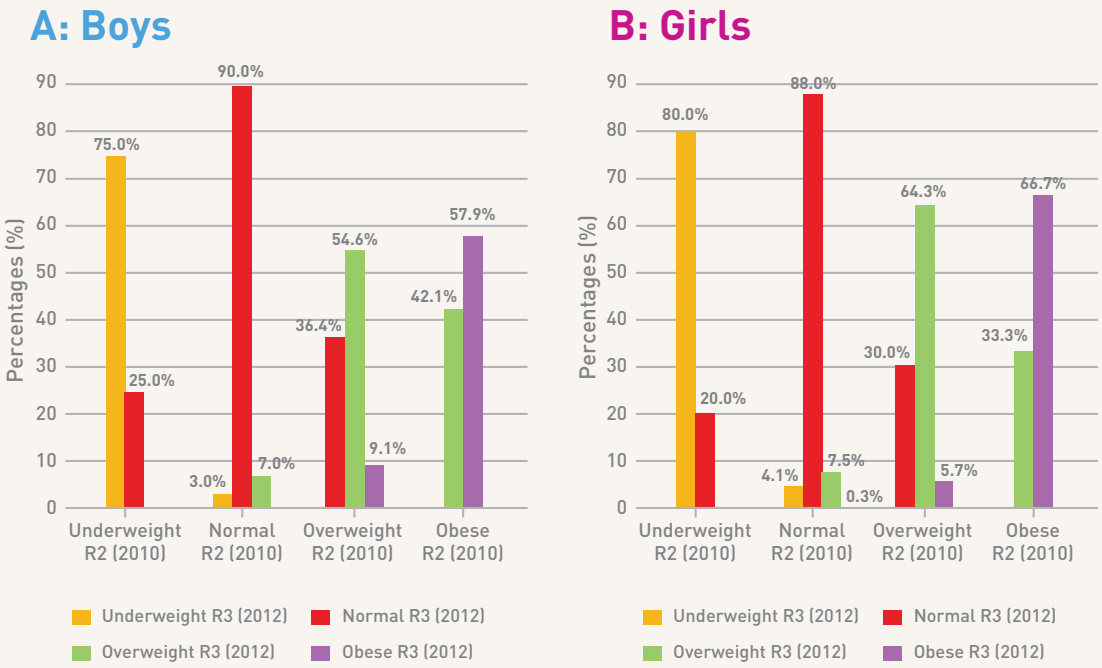


FIGURE 15 Longitudinal change in body mass index categorization using IOTF cut-off points for boys (panel A) and girls (panel B) who were in Third class in 2010 (R2; median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012 (R3). Underweight: 8 boys, 20 girls; normal weight: 271 boys, 336 girls; overweight: 44 boys, 70 girls; obese: 19 boys, 18 girls.

One fourth of the boys (n=2; left of panel A, Figure 15) and one fifth of the girls (n=4; left of panel B, Figure 15) who were underweight in Third class in 2010 (Round 2), were normal weight when in Fifth class in 2012 (Round 3). Of the boys and girls who had a normal weight in 2010, the majority still had a normal BMI in 2012 (Figure 15). For overweight boys and girls in 2010, one third became normal weight in 2012, but over 50% remained overweight. For obese boys and girls in 2010, the majority were still obese in 2012 (right of panel A and B, respectively).

Overall, the majority of underweight and overweight boys and girls who were in First class in 2010, were still in the same IOTF category two years later in 2012 when they were in Third class. The same applied for underweight and overweight boys and girls who were in Third class in 2010 and in Fifth class in 2012. Among those who were underweight, 32 out of 38 were both in 2010 and 2012 in the 'mild thinness' IOTF category (BMI 17.0-<18.5 kg/m^2). One child with moderate thinness (BMI 16.0-<17.0 kg/m^2) in 2010 changed to the 'mild thinness' category in 2012. Five children were in the 'moderate thinness' category in both 2010 and 2012 and none of the children were severely thin (BMI <16.0 kg/m^2).

For the overweight and obese children it seems a shift to the left took place. Of the overweight and obese boys and girls who were in First class in 2010, 16-25% were either normal weight or overweight respectively when in Third class 2012. Of the overweight and obese boys and girls who were in Third class in 2010, this percentage was even higher ranging from 30-42%.

Some descriptive tables on anthropometric measures, including results stratified by disadvantaged schools and by HSE region, are presented in Appendix 2.

COMPARISON OF COSI DATA WITH GROWING UP IN IRELAND DATA: RESULTS OF 9-YEAR-OLD CHILDREN

AVAILABLE DATA ON ANTHROPOMETRY

In Table 13, all available Irish studies containing anthropometric data in children are presented. Most notably, there is much data available for 9-year-olds.

TABLE 13 Anthropometric data in children available in Irish studies

	BIRTH	3 Y	5 Y	6 Y	7 Y	9 Y	11 Y	12 Y	13 Y
North South Survey of Children's Oral Health (2001-2002)			X (2001/2)	X (2001/2)	X (2001/2)	X (2001/2)		X (2001/2)	
HRB Lifeways Cross-Generation Cohort Study (2001-2013)	X		X (2007/8)			X (2012)			
Growing Up in Ireland - National Longitudinal Survey of Children (2008-ongoing)	X	X	X			X (2008)			X (2012)
HSE West surveillance of six-year-old children (2004-2006)				X (2004-6)					
WHO Childhood Obesity Surveillance Initiative (Ireland) (2008-2013)	X				X (2008) (2010) (2012/13)	X (2010) (2012/13)	X (2012/13)		
Cork Children's Lifestyle Study (2012-2013)						X (2012/13)			
ROLO study - RCT of low GI diet in the prevention of recurrence of macrosomia (2007-ongoing)			X (are followed up)						
National Pre-school Nutrition Survey (2010-2011)		X							
National Children's Food Survey (2003-2004)			X	X	X	X	X	X	
The National Teens' Food Survey (2005-2006)									X

COMPARISON OF COSI DATA WITH GROWING UP IN IRELAND DATA

Table 14 presents data on weight, height and BMI in 9-year-old children of both Round 2 (2010) and 3 (2012) of the WHO COSI study with the largest study that of 9-year-olds, the Growing Up in Ireland (GUI) Cohort study (2008).

TABLE 14 Differences in height, weight and body mass index (BMI) comparing Childhood Obesity Surveillance Initiative (COSI) data and the Growing Up in Ireland (GUI) data for 9-year-old boys and girls*

ANTHROPOMETRIC MEASURE	GENDER	ROUND	N	MEAN (SD†)	MEDIAN	MINIMUM	MAXIMUM
Weight (kg)	**Boys**	**GUI (2008)**	**3899**	**33.7 (6.9)**	**32**	**21**	**57**
		COSI R2 (2010)	**503**	**33.0 (6.3)**	**32.0**	**20.7**	**63.1**
		COSI R3 (2012)	**564**	**33.2 (6.6)**	**31.9**	**21.9**	**69.1**
	Girls	**GUI (2008)**	**4107**	**33.7 (7.3)**	**32**	**21**	**57**
		COSI R2 (2010)	**482**	**32.4 (6.9)**	**31.3**	**20.2**	**61.4**
		COSI R3 (2012)	**537**	**32.7 (6.7)**	**31.4**	**21.5**	**60.0**
Height (cm)	**Boys**	**GUI (2008)**	**3899**	**137.6 (6.2)**	**137**	**121**	**152**
		COSI R2 (2010)	**503**	**136.4 (5.9)**	**136.4**	**121.5**	**153.1**
		COSI R3 (2012)	**564**	**136.5 (6.0)**	**136.7**	**114.7**	**155.4**
	Girls	**GUI (2008)**	**4107**	**136.6 (6.2)**	**137**	**121**	**152**
		COSI R2 (2010)	**482**	**135.0 (6.4)**	**135.0**	**117.1**	**153.9**
		COSI R3 (2012)	**537**	**135.4 (6.0)**	**135.3**	**118.5**	**152.2**
BMI (kg/m²)	**Boys**	**GUI (2008)**	**3899**	**17.7 (2.8)**	**17.1**	**10.6**	**36.3**
		COSI R2 (2010)	**503**	**17.7 (2.5)**	**17.2**	**13.2**	**27.7**
		COSI R3 (2012)	**564**	**17.7 (2.7)**	**17.1**	**13.0**	**31.0**
	Girls	**GUI (2008)**	**4107**	**18.0 (3.1)**	**17.3**	**9.5**	**37.1**
		COSI R2 (2010)	**482**	**17.7 (2.8)**	**17.2**	**11.8**	**31.3**
		COSI R3 (2012)	**537**	**17.7 (2.7)**	**17.1**	**12.9**	**29.6**

** Since the minimum and maximum values of weight and height presented from GUI are truncated, no statistical test has been performed for comparison of the data. † SD, standard deviation*

When looking at the mean, standard deviation, and median values, weight, height and BMI are comparable between these two studies (Table 14).

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Below, a table presents all those who have worked on the several rounds of the WHO COSI study and their specific role(s).

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APPENDICES

APPENDIX 1: RESULTS OF CHILDREN NOT INCLUDED IN MAIN REPORT

TABLE I Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 5 years

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**7**	**23.4**	**22.1-32.9**	**19.6**	**34.0**
	Height (cm)	**7**	**121.2**	**118.9-125.7**	**116.1**	**133.6**
	Waist (cm)	**7**	**53.5**	**51.2-64.2**	**51.0**	**66.3**
	BMI (kg/m²)	**7**	**15.9**	**15.1-19.0**	**14.5**	**20.8**
Girls	**Weight (kg)**	**10**	**23.1**	**22.3-24.6**	**18.0**	**25.6**
	Height (cm)	**10**	**119.3**	**117.9-123.5**	**109.0**	**127.6**
	Waist (cm)	**10**	**54.2**	**52.1-58.5**	**48.7**	**61.0**
	BMI (kg/m²)	**10**	**15.9**	**15.2-16.4**	**14.2**	**17.6**

TABLE II Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 6 years

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**677**	**24.2**	**22.2-26.4**	**16.8**	**43.7**
	Height (cm)	**677**	**122.2**	**118.8-125.5**	**105.0**	**144.8**
	Waist (cm)	**676**	**55.1**	**52.9-58.2**	**45.5**	**85.1**
	BMI (kg/m²)	**677**	**16.1**	**15.4-17.2**	**10.3**	**27.6**
Girls	**Weight (kg)**	**777**	**23.9**	**21.7-26.8**	**15.3**	**50.0**
	Height (cm)	**777**	**120.8**	**117.7-124.5**	**104.1**	**139.4**
	Waist (cm)	**777**	**56.1**	**53.0-60.1**	**45.0**	**85.2**
	BMI (kg/m²)	**777**	**16.3**	**15.3-17.8**	**11.7**	**28.6**

TABLE III Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 7 years in Third class

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**10**	**34.6**	**27.3-39.2**	**22.7**	**55.3**
	Height (cm)	**10**	**134.5**	**130.0-138.7**	**125.1**	**147.6**
	Waist (cm)	**10**	**66.5**	**58.0-72.9**	**56.9**	**98.2**
	BMI (kg/m²)	**10**	**17.9**	**16.3-22.7**	**14.5**	**28.7**
Girls	**Weight (kg)**	**13**	**32.3**	**29.1-34.0**	**25.5**	**51.1**
	Height (cm)	**13**	**132.2**	**128.9-135.0**	**124.5**	**144.8**
	Waist (cm)	**13**	**62.6**	**58.7-63.8**	**55.1**	**80.4**
	BMI (kg/m²)	**13**	**18.7**	**17.5-19.3**	**15.0**	**24.4**

TABLE IV Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 8 years

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**627**	**29.8**	**26.7-34.1**	**19.7**	**62.0**
	Height (cm)	**627**	**132.6**	**128.9-137.1**	**113.0**	**154.9**
	Waist (cm)	**627**	**59.0**	**55.8-63.2**	**47.4**	**96.8**
	BMI (kg/m²)	**627**	**16.8**	**15.8-18.5**	**12.9**	**30.4**
Girls	**Weight (kg)**	**762**	**30.1**	**26.7-35.1**	**18.4**	**61.5**
	Height (cm)	**762**	**131.9**	**128.2-136.5**	**109.2**	**156.7**
	Waist (cm)	**760**	**59.6**	**55.8-65.6**	**29.4**	**89.6**
	BMI (kg/m²)	**762**	**17.2**	**15.9-19.3**	**12.9**	**30.4**

TABLE V Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 9 years in Fifth class

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**4**	**41.2**	**34.8-49.1**	**30.7**	**54.8**
	Height (cm)	**4**	**147.9**	**141.1-152.9**	**138.5**	**153.2**
	Waist (cm)	**4**	**69.0**	**64.2-76.6**	**60.0**	**83.5**
	BMI (kg/m^2)	**4**	**18.7**	**17.3-21.3**	**16.0**	**23.7**
Girls	**Weight (kg)**	**6**	**35.4**	**35.0-46.7**	**29.3**	**54.0**
	Height (cm)	**6**	**143.8**	**135.9-150.5**	**130.0**	**155.1**
	Waist (cm)	**6**	**62.1**	**57.0-71.3**	**55.0**	**84.9**
	BMI (kg/m^2)	**6**	**18.5**	**17.3-19.4**	**15.7**	**24.7**

TABLE VI Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 10 years

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**242**	**37.2**	**32.8-43.0**	**23.9**	**70.9**
	Height (cm)	**242**	**144.2**	**140.3-148.0**	**127.8**	**158.7**
	Waist (cm)	**242**	**63.3**	**59.4-69.9**	**49.7**	**101.4**
	BMI (kg/m^2)	**242**	**17.9**	**16.4-20.1**	**13.3**	**30.4**
Girls	**Weight (kg)**	**309**	**38.0**	**33.2-45.1**	**22.9**	**73.3**
	Height (cm)	**309**	**145.0**	**139.4-149.6**	**116.5**	**167.8**
	Waist (cm)	**309**	**63.2**	**58.3-70.6**	**48.4**	**101.3**
	BMI (kg/m^2)	**309**	**18.2**	**16.4-20.7**	**13.0**	**31.7**

TABLE VII Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 11 years

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**311**	**39.3**	**35.2-45.4**	**25.4**	**65.1**
	Height (cm)	**311**	**147.2**	**143.1-151.6**	**132.9**	**178.1**
	Waist (cm)	**311**	**63.9**	**60.1-69.8**	**51.3**	**91.3**
	BMI (kg/m²)	**311**	**18.1**	**16.5-20.1**	**13.6**	**28.4**
Girls	**Weight (kg)**	**295**	**40.1**	**34.8-46.9**	**25.5**	**75.3**
	Height (cm)	**295**	**147.5**	**143.1-152.9**	**130.1**	**165.8**
	Waist (cm)	**295**	**64.3**	**59.8-69.4**	**51.5**	**93.7**
	BMI (kg/m²)	**295**	**18.3**	**16.5-20.4**	**13.2**	**33.3**

TABLE VIII Weight, height, waist circumference and body mass index (BMI) in boys and girls aged 12 years

GENDER	ANTHROPOMETRIC MEASURE	N	MEDIAN	P25-P75	MINIMUM	MAXIMUM
Boys	**Weight (kg)**	**16**	**46.7**	**38.9-49.0**	**30.2**	**86.4**
	Height (cm)	**16**	**154.1**	**148.5-155.8**	**141.4**	**165.5**
	Waist (cm)	**16**	**67.3**	**59.3-71.3**	**53.9**	**108.0**
	BMI (kg/m²)	**16**	**18.7**	**16.8-20.7**	**15.1**	**35.5**
Girls	**Weight (kg)**	**8**	**39.3**	**35.4-46.3**	**32.3**	**60.3**
	Height (cm)	**8**	**149.6**	**142.5-154.7**	**136.1**	**158.9**
	Waist (cm)	**8**	**67.0**	**62.6-73.4**	**59.6**	**81.9**
	BMI (kg/m²)	**8**	**18.0**	**16.7-20.1**	**15.6**	**25.9**

APPENDIX 2: RESULTS OF LONGITUDINAL ANALYSES

OVERALL GROUP

TABLE I. Longitudinal comparison of height, weight, waist circumference and body mass index (BMI) over time for boys and girls who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3)

ANTHROPOMETRIC MEASURE	GENDER	N	MEASUREMENT IN ROUND 2 (2010)		MEASUREMENT IN ROUND 3 (2012)	
			Median (P25-P75)	**Min-max**	**Median (P25-P75)**	**Min-max**
Weight (kg)	**Boys**	**296**	**25.2 (22.9-27.9)**	**16.0-45.2**	**31.9 (28.4-36.3)**	**19.8-66.8**
	Girls	**374**	**24.4 (22.1-26.9)**	**16.5-43.8**	**31.1 (27.6-34.8)**	**20.5-58.6**
Height (cm)	**Boys**	**296**	**124.3 (121.3-127.9)**	**108.2-137.0**	**136.6 (133.0-140.8)**	**119.2-151.6**
	Girls	**373**	**122.4 (118.9-125.7)**	**107.8-137.6**	**134.8 (130.7-138.6)**	**116.4-152.0**
Waist (cm)	**Boys**	**296**	**56.1 (53.8-60.1)**	**45.9-84.1**	**60.1 (57.3-64.9)**	**49.5-99.9**
	Girls	**372**	**55.9 (52.7-59.9)**	**46.0-81.5**	**59.6 (55.1-64.8)**	**47.2-98.6**
BMI (kg/m^2)	**Boys**	**296**	**16.2 (15.5-17.3)**	**12.7-27.3**	**16.9 (15.9-18.8)**	**12.7-29.2**
	Girls	**373**	**16.3 (15.3-17.4)**	**12.8-26.9**	**17.1 (15.8-19.0)**	**13.3-29.6**

TABLE II Longitudinal comparison of height, weight, waist circumference and body mass index (BMI) over time for boys and girls who were in Third class in 2010 (R2; median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012 (R3)

ANTHROPOMETRIC MEASURE	GENDER	N	MEASUREMENT IN ROUND 2 (2010)		MEASUREMENT IN ROUND 3 (2012)	
			Median (P25-P75)	**Min-max**	**Median (P25-P75)**	**Min-max**
Weight (kg)	**Boys**	**342**	**31.5 (28.1-35.2)**	**20.5-63.1**	**38.8 (34.5-44.5)**	**24.9-90.5**
	Girls	**400**	**30.1 (26.8-34.5)**	**19.1-61.4**	**38.8 (33.5-45.7)**	**24.7-82.1**
Height (cm)	**Boys**	**342**	**135.9 (131.5-139.2)**	**117.4-153.1**	**146.9 (142.4-151.3)**	**127.7-170.8**
	Girls	**402**	**133.0 (129.1-137.5)**	**117.1-154.1**	**145.5 (141.0-150.9)**	**124.8-167.4**
Waist (cm)	**Boys**	**341**	**60.2 (57.0-64.5)**	**51.1-92.2**	**64.0 (60.4-68.9)**	**50.2-129.7**
	Girls	**401**	**59.2 (55.8-64.3)**	**49.6-87.7**	**63.2 (58.5-69.8)**	**32.3-106.5**
BMI (kg/m^2)	**Boys**	**342**	**17.1 (16.0-18.5)**	**12.7-27.4**	**18.1 (16.6-19.9)**	**13.0-31.2**
	Girls	**400**	**17.0 (15.6-18.8)**	**13.2-31.3**	**18.0 (16.4-20.5)**	**13.6-34.6**

HSE REGIONS

TABLE III Comparisons of prevalence of overweight (including obesity) and obesity (categorised using IOTF standards) over time by HSE region in boys and girls who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3)

HSE REGION	ROUND	TOTAL N (BOYS/ GIRLS)	PREVALENCE OF OVERWEIGHT (INCLUDING OBESITY)				PREVALENCE OF OBESITY			
			BOYS		GIRLS		BOYS		GIRLS	
			%	n	%	n	%	n	%	n
South	**R2 (2010)**	**93/111**	**16.3**	**15**	**18.9**	**21**	**6.5**	**6**	**5.4**	**6**
	R3 (2012)	**93/111**	**20.4**	**19**	**20.7**	**23**	**5.4**	**5**	**5.4**	**6**
Dublin North-East	**R2 (2010)**	**96/126**	**16.7**	**16**	**27.8**	**35**	**1.0**	**1**	**7.9**	**10**
	R3 (2012)	**96/126**	**16.7**	**16**	**25.4**	**32**	**3.1**	**3**	**7.9**	**10**
Dublin Mid-Leinster	**R2 (2010)**	**76/99**	**17.1**	**13**	**17.2**	**17**	**6.6**	**5**	**2.0**	**2**
	R3 (2012)	**76/99**	**23.7**	**18**	**25.3**	**25**	**6.6**	**5**	**1.0**	**1**
West	**R2 (2010)**	**31/37**	**16.1**	**5**	**18.9**	**7**	**0**	**0**	**2.7**	**1**
	R3 (2012)	**31/37**	**23.7**	**6**	**24.3**	**9**	**0**	**0**	**5.4**	**2**

TABLE IV Comparisons of prevalence of overweight (including obesity) and obesity (categorised using IOTF standards) over time by HSE region in boys and girls who were in Third class in 2010 (R2; median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012 (R3)

HSE REGION	ROUND	TOTAL N (BOYS/ GIRLS)	PREVALENCE OF OVERWEIGHT (INCLUDING OBESITY)				PREVALENCE OF OBESITY			
			BOYS		GIRLS		BOYS		GIRLS	
			%	n	%	n	%	n	%	n
South	**R2 (2010)**	**94/104**	**19.2**	**18**	**15.4**	**16**	**7.5**	**7**	**4.8**	**5**
	R3 (2012)	**94/104**	**22.3**	**21**	**17.3**	**18**	**6.4**	**6**	**2.9**	**3**
Dublin North-East	**R2 (2010)**	**106/122**	**16.0**	**17**	**23.0**	**28**	**4.7**	**5**	**3.3**	**4**
	R3 (2012)	**106/122**	**18.9**	**20**	**21.3**	**26**	**2.8**	**3**	**2.5**	**3**
Dublin Mid-Leinster	**R2 (2010)**	**98/98**	**18.4**	**18**	**25.5**	**25**	**4.1**	**4**	**7.1**	**7**
	R3 (2012)	**98/98**	**17.4**	**17**	**27.6**	**27**	**5.1**	**5**	**9.2**	**9**
West	**R2 (2010)**	**44/76**	**22.7**	**10**	**25.0**	**19**	**6.8**	**3**	**2.6**	**2**
	R3 (2012)	**44/76**	**18.2**	**8**	**25.0**	**19**	**2.3**	**1**	**2.6**	**2**

DISADVANTAGED SCHOOLS

TABLE V Comparisons of prevalence of overweight (including obesity) and obesity (categorised using IOTF standards) over time by disadvantaged schools in boys and girls who were in First class in 2010 (R2; median age boys: 7.1 y and girls: 7.0 y) and in Third class in 2012 (R3)

ROUND	BOYS				GIRLS			
	SCHOOL TYPE				SCHOOL TYPE			
	DISADVANTAGED		OTHER SCHOOLS		DISADVANTAGED		OTHER SCHOOLS	
Total n	**20**		**276**		**5**		**368**	
Prevalence of overweight (including obesity)								
	%	n	%	n	%	n	%	n
R2 (2010)	**15.0**	**3**	**16.7**	**46**	**0**	**0**	**21.7**	**80**
R3 (2012)	**20.0**	**4**	**19.9**	**55**	**20.0**	**1**	**23.9**	**88**
Prevalence of obesity								
	%	**n**	**%**	**n**	**%**	**n**	**%**	**n**
R2 (2010)	**5.0**	**1**	**4.0**	**11**	**0**	**0**	**5.2**	**19**
R3 (2012)	**10.0**	**2**	**4.0**	**11**	**0**	**0**	**5.2**	**19**

TABLE VI Comparisons of prevalence of overweight (including obesity) and obesity (categorised using IOTF standards) over time by disadvantaged schools in boys and girls who were in Third class in 2010 (R2; median age boys: 9.1 y and girls: 9.0 y) and in Fifth class in 2012 (R3)

ROUND	BOYS				GIRLS			
	SCHOOL TYPE				SCHOOL TYPE			
	DISADVANTAGED		OTHER SCHOOLS		DISADVANTAGED		OTHER SCHOOLS	
Total n	**20**		**276**		**5**		**368**	
Prevalence of overweight (including obesity)								
	%	n	%	n	%	n	%	n
R2 (2010)	**26.5**	**9**	**17.5**	**54**	**32.1**	**9**	**21.2**	**79**
R3 (2012)	**29.4**	**10**	**18.2**	**56**	**32.1**	**9**	**21.8**	**81**
Prevalence of obesity								
	%	**n**	**%**	**n**	**%**	**n**	**%**	**n**
R2 (2010)	**8.8**	**3**	**5.2**	**16**	**3.6**	**1**	**4.6**	**17**
R3 (2012)	**5.9**	**2**	**4.2**	**13**	**3.6**	**1**	**4.3**	**16**