The Childhood Obesity Surveillance Initiative (COSI) in the Republic of Ireland

Findings from 2008, 2010, 2012 and 2015

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A Hub for Data Collation, Research, Education & Communication

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Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

The Childhood Obesity Surveillance Initiative (COSI) in the Republic of Ireland: Findings from 2015/2016

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Foreword

I very much welcome the publication of this report which sets out the trends observed in relation to healthy weight, overweight and obesity in primary school children in Ireland over the period 2008 to 2015. Drawing on data from more than 17,000 examinations of primary school children it paints a compelling picture. Over the four rounds of the surveillance (2008-2015) some key trends have emerged including:

- the levels of overweight and obesity in 1st class children (age 7 years) and those aged 8 years appear to be stabilising albeit at a high level,
- this stablisation is not observed in those children attending DEIS schools; and
- there is a marked difference across genders with more girls tending to be overweight and obese than boys.

The trends evident from the surveillance reveal that the patterning of health inequality emerges early in life. When data from children attending DEIS schools is compared with that of children attending other schools, those attending DEIS schools tend to have higher levels of overweight and obesity and the gap becomes wider as children get older.

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 overweight and obesity is a significant risk factor for the development of chronic diseases such as cardiovascular disease and type 2 diabetes as well as certain cancers. And we know that childhood obesity tracks strongly into adulthood bringing with it all the inherent risk factors. More worryingly there is emerging evidence of many chronic illnesses previously only seen in adult populations, such as high blood pressure, type 2 diabetes emerging that children and young people.

In 2016, under the Healthy Ireland Framework, the Government published Healthy Weight for Ireland: Obesity Policy and Action Plan which sets a clear short-term target for a sustained downward trend in levels of excess weight in children and a reduction in the gap in obesity levels between the highest and lowest socio-economic groups by 10%. The ten steps forward set out in the Action Plan to achieve this target require coordinated and focused action across multiple sectors including industry, the built environment and transport, education, health, communities and individuals

The findings of this report indicate that we still have a significant way to go to create environments in our homes, schools and communities that support every child to grow and develop healthily from birth through to adulthood. Lifestyles and health are intrinsically linked and are heavily influenced by the prevailing environment. The development and nurturing of healthy lifestyles must occur across the life course at individual, community and societal level, if we are to successfully achieve a population shift away from our current tendency towards unhealthy weight and the consequent risks of chronic disease and their impacts at individual and population level.

I would like to thank the National Nutrition Surveillance Centre, who were commissioned to carry out this research. In particular I wish to acknowledge and thank the children who participated in the body measurements and their parents for agreeing to participate. In doing so they provide us with a vital tool for monitoring the impact of our efforts to promote healthy lifestyles and prevent childhood obesity.

Sarah O'Brien
National Lead Healthy Eating Active Living Policy Priority Programme
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Executive summary

Childhood Obesity Surveillance Initiative in the Republic of Ireland

The prevalence of obesity in children has been rising rapidly, leading to many serious health consequences worldwide. In 2008, the 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. Furthermore, data collection on possible risk factors contributing to childhood obesity was also encouraged. The Department of Health and the Health Service Executive commissioned the National Nutrition Surveillance Centre, based at the School of Public Health, Physiotherapy and Sports Science in University College Dublin, to carry out this surveillance work in the Republic of Ireland. This Irish survey is affiliated with the WHO European Childhood Obesity Surveillance Initiative, which was set up in 2006 by the WHO Regional Office for Europe, with an initial 13 Member States participating.

Study population

The current report presents findings from four waves of the WHO Childhood Obesity Surveillance Initiative survey in the Republic of Ireland in 2008, 2010, 2012 and 2015. 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 group was children aged exactly 7 years in First class. In the subsequent three waves, the same WHO protocol was followed and the same schools were contacted. As in Round 1, the target age group in Round 2, Round 3 and Round 4 was 7-year-old children in First class.

Cross-sectional surveys

First class children in Round 2 were examined again two years later in Third class (9 years old) in Round 3 and five years later in Sixth class (12 years old) in Round 4. A second cohort of children was measured in Third class in Round 2 and in Fifth class (11 years old) in Round 3. First class children in Round 3 were examined again three years later in Fourth class (10 years old) in Round 4. This means that there are four 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-, 10-, 11- and 12-year-old children. In this report, we present the findings from the cross-sectional surveys of 7-year-old children and of ≥8-year-old children, separately.

Key findings

- **Over the four waves, data from a total of 17,145 examinations were available. In the first data collection round (2008), 163 Irish primary schools participated. In the second (2010), third (2012) and fourth (2015) data collection rounds, 152, 159 and 138 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 and 2,016 Third class students were examined. In Round 3 (2012), 1,729 First class, 1,945 Third class and 1,903 Fifth class students had their measurements recorded. In Round 4 (2015), 1,531 First class, 1,647 Fourth class and 1,731 Sixth class children were examined.**
- **According to the International Obesity Task Force standards, the percentages of overweight and obesity in First class children were 21.6% in Round 1, 20.8% in Round 2, 16.8% in Round 3 and 16.9% in Round 4 (p-value for inverse trend $p<0.001$). Measurements in Round 1 took place in summer and children were, therefore, older than those examined in the other three rounds as examinations were undertaken in autumn (Round 2), and during winter and spring time (Rounds 3 and 4). However, children's chronological age seems to explain the higher rates observed in Round 1 rather than a seasonal effect. When children were split into 6-months intervals of age, results showed a significant temporal effect towards the stabilisation of overweight and obesity rates across rounds in Irish First class children. On the other hand, the decline in participation rates over time among First class children could be linked to a certain degree of participation bias, mainly among the overweight and obese, resulting in lower overweight and obesity rates.**
- **The prevalence of obesity among First class boys was 17.2%, 15.5%, 13.5% and 13.2% for the first, second, third and fourth rounds, respectively (p-value for inverse trend $p=0.011$). For girls, these percentages were 25.3%, 25.7%, 20.0% and 20.4%, respectively (p-value for inverse trend $p<0.001$). Overall, the prevalence of overweight and obesity was significantly higher (p-value <0.001) in girls compared with boys across all rounds. Significant inverse trends for overweight (including obesity) were observed for First class children in non-disadvantaged schools (p-value for trend <0.001), whereas no significant trend ($p>0.05$) was observed for disadvantaged schools across rounds. Overweight and obesity rates for Round 4 in disadvantaged schools were the lowest as compared with previous rounds.**
- **Percentages of overweight and obesity when categorised by International Obesity Task Force standards for boys aged ≥8 years were 23.5%, 22.4%, 20.7%, 14.5% and 18.0% for Third class (Round 2), Third class (Round 3), Fifth class (Round 3), Fourth class (Round 4) and Sixth class (Round 4), respectively. The percentages of overweight and obesity for girls aged ≥8 years were 30.0%, 26.5%, 23.3%, 24.8% and 22.9% for Third class (Round 2), Third class (Round 3), Fifth class (Round 3), Fourth class (Round 4) and Sixth class (Round 4), respectively. Girls were more overweight and obese than boys; this difference reached significance ($p<0.001$) among Fourth class children in Round 4. Overall, both boys and girls showed a stabilisation in the prevalence of overweight and obesity across rounds and with age. Disadvantaged schools had higher prevalence of overweight and obesity in comparison with children in non-disadvantaged schools. While the prevalence of overweight and obesity in children in non-disadvantaged schools could be stabilising across rounds, overweight and obesity rates among children older than 8 years in disadvantaged schools seem to increase as they grow up.**

In conclusion, the prevalence of overweight of obesity in Irish First class children could be stabilising; however, no trend was observed for First class children in disadvantaged schools. Among children aged ≥8 years, overweight and obesity rates seems to be stabilising as children become older; however, children attending disadvantaged schools show higher prevalence with age.

Introduction

The prevalence of childhood obesity has risen rapidly during the last decades. In 2014, the World Health Organisation (WHO) estimated that about 41 million children under the age of 5 years were overweight or obese (1). Although there is evidence of a potential stabilisation in several countries, current overweight and obesity rates are still too high. Projected prevalence of overweight, including obesity, shows global overweight prevalence for children aged 5-17 years rising from 14.2% in 2013 to 15.8% in 2025, from which 5.4% will be obese (2). Overweight and obesity are linked to more deaths worldwide than underweight and, globally, there are more people who are obese than underweight (1).

Obesity has been estimated to cost the European Union €70 billion annually through healthcare costs and lost productivity (3). For the Republic of Ireland, the direct and indirect costs of overweight and obesity in 2009 were estimated at €1.13 billion (4). It is estimated that diseases linked to overweight and obesity account for between 5% and 7% of total health care costs in Europe (3). The increase in the prevalence of obesity in childhood and adolescence occurs in conjunction with the increase in the prevalence of comorbidities including glucose intolerance, type 2 diabetes, hypertension, and hyperlipidaemia (5). Abnormalities in the gastrointestinal, pulmonary, orthopaedic, neurologic, dermatologic, and psychosocial systems are also linked to obesity (6). Although some of these comorbidities were exclusively observed in adult populations, they are now regularly observed in obese children. In addition, overweight and obesity during childhood and adolescence track into adulthood and have been shown to increase the risk of chronic disease, such as cardiovascular disease or cancer, and premature death during adulthood, regardless of being obese during adulthood (7-10). The Bogalusa Heart Study linked childhood obesity to early pathological vascular changes (11) and associated overweight in adolescence with hypertension and lipid and cholesterol abnormalities in later adult life (12). A cohort of 276,835 Danish children found body mass index (BMI) to be linearly associated with future coronary heart events (13).

In 2002, the Irish North-South National Children's Food 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 (14). The survey was 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 (15). Two smaller Irish studies observed a similar prevalence of overweight and obesity: 24.6% for data collected in 2007 in children aged 4-13 years (16) and 27% for data collected between 2004 and 2007 in children aged 6 (17). The National Taskforce on Obesity (2005) (18) reported that in Ireland over 300,000 children were estimated to be overweight and obese and this was projected to increase annually by 10,000.

In 2005, the 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 (19). Preventing the rise in levels of overweight and obesity was a significant challenge for the Irish government. Therefore, in 2005, The Department of Health published the report of the National Taskforce on Obesity (18). As part of its plan for tackling obesity, the Taskforce 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 Sports Science in University College Dublin (UCD) to commence this surveillance work among primary school children in the Republic of Ireland. The following three rounds in 2010, 2012 and 2015 were commissioned by the HSE. In 2016, the Department of Health launched the Obesity Policy and Action Plan 2016-2025 'A Healthy Weight for Ireland' (20), as part of the Healthy Ireland initiative. The document states short-term targets for overweight and obesity to be achieved in a five-year time frame. These include a decrease of 0.5% per year in the level of excess weight in children and a reduction in the gap in obesity levels between the highest and lowest socioeconomic groups by 10%. The policy also presents the 'Ten Steps Forward', which gathers a number of priority actions to be taken in order to prevent overweight and obesity and achieve the short-term targets. The priority action areas under Step 10 'Monitor research and review' include, among others, 'to sustain ongoing obesity surveillance through Healthy Ireland and Childhood Obesity Surveillance Initiative (COSI) as means of monitoring progress.' Regular surveillance of weight status among Irish children will be essential to monitor any changes occurring in terms of childhood obesity in order to inform the policy and to evaluate the progress on achieving these targets.

Aims and objectives

The Irish COSI is an ongoing, systematic process of collection, analysis interpretation and dissemination of descriptive information for monitoring obesity, identified as a serious public health problem in the WHO European region (21) and for use in programme planning and evaluation (19).

The system aims to measure trends in overweight and obesity in primary school children 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 involves applying a test to a defined group of persons in order to identify a risk factor or a combination of risk factors of a disease at an early stage – the people who are identified as 'at risk' are then treated. By contrast, surveillance collects anonymised data in a representative sample of people to monitor trends and for policy and planning purposes.

The core objective of COSI in Ireland is to measure in primary school children:

- **Weight, height, body mass index (BMI) and waist circumference.**
- **Prevalence of underweight, normal weight, overweight and obesity.**

Methods

Study design

The WHO European COSI is a collaborative study with principal investigators from all countries co-operating in relation to survey content, methodology and timing using a common European protocol. The Irish surveillance system followed the protocol of the WHO European COSI, which was jointly developed by the WHO Regional Office for Europe and the participating Member States. Strict adherence to the original protocol was required for inclusion in the European database and this procedure was achieved with the current study.

More details about the cluster-sampling procedure and the sample size calculations were previously described in the first report (22). In summary, 163 schools consented to take part in this study in Round 1 (2008) and children in First class were measured. Only one First class per school was sampled, even if there were multiple First classes in the school. Those same 163 schools were contacted again for Round 2, Round 3 and Round 4 for data collection in 2010, 2012 and 2015, 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, 3 and 4. Junior schools include Junior infants, Senior infants and First class, whereas senior schools include Second to Sixth classes. One of the goals of the subsequent rounds was to follow up those children measured previously. Therefore, in Round 2 (2010) not only First class was included, but also Third class; in Round 3 (2012), First, Third and Fifth class were included, and in Round 4 (2015), First, Fourth as well as Sixth class were included. Also for Rounds 2, 3 and 4, only one class from each year was selected per school.

Subjects

Originally, the children in First, Third and Fifth class were chosen because these classes include children with the exact ages of 7, 9 and 11 years, respectively. Fourth and Sixth class were selected in Round 4 to follow those children in First class and Third class in Round 3, respectively. These age groups precede puberty (23) and at these ages the identification of obesity is of value to predict the condition in adulthood (24).

Ethical considerations

Ethical approval was obtained from the Research Ethics Committee, Human Research Sub Committee, UCD, on all four occasions (2008, 2010, 2012 and 2015).

Consent was obtained on three levels: at school, parent and child level. Within each round, an initial letter and a consent form were sent to the 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. Parents were fully informed about all study procedures and a signed 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), Round 3 (2012) and Round 4 (2015).

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 cabins 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). These forms were also available in Irish and this translation was conducted by a professional translator. Moreover, only for Round 1, Polish forms, translated by a professional translator, were available.

Training

Prior to their recruitment, all candidates were required to undergo the police vetting process to disclose any criminal convictions. For Round 1 (2008), 30 graduate nutritionists were recruited to carry out the fieldwork. For Round 2 (2010), Round 3 (2012) and Round 4 (2015), 15, 17 and 19 nutritionists were recruited, respectively. All researchers attended a training session in anthropometric measurements and data collection, following a standardised protocol drawn up by the WHO. The 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). For Round 4, measurements commenced on 5th November 2015 and continued until 2nd February 2016 (13-week period with a 3-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 stadiometres were used throughout. For Round 3 (2012) and Round 4 (2015), Leicester Height Measure portable stadiometres were used throughout. Weight measurements were taken with HD-305 Tanita scales in Round 3 and with Tanita WB-100 MA scales in Round 4. For all four 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 and 2015 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 (25). 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 stadiometres 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, sex, 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 from both First class and Third class children 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 was obtained. During Round 3 and Round 4, only parents of the First class cohort were asked to fill in this Family Survey form, since data of the other age cohorts were already measured in previous rounds. A report describing the Family Survey data collected in Round 2 and Round 3 was published (26).

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. 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 (25).

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 for Rounds 1 to 3, which were emailed back to the NNSC. For Round 4, data were recorded into an electronic data entry system, OpenClinica. Data were checked for inconsistencies. The final dataset only included children with informed consent and complete information on age and sex.

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 (27) 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 were used to calculate z-scores (27), 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 (28, 29) 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.

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. Waist circumference extreme values were checked and children with unrealistic measurements were excluded (<30 cm or >110 cm) compared to their weight and height (n=2).

Analyses included children in First class aged 6-7 years and children in Third, Fourth, Fifth and Sixth class aged 8-13 years (Table 2).

Table 2

Classes and age ranges included in the analysis.

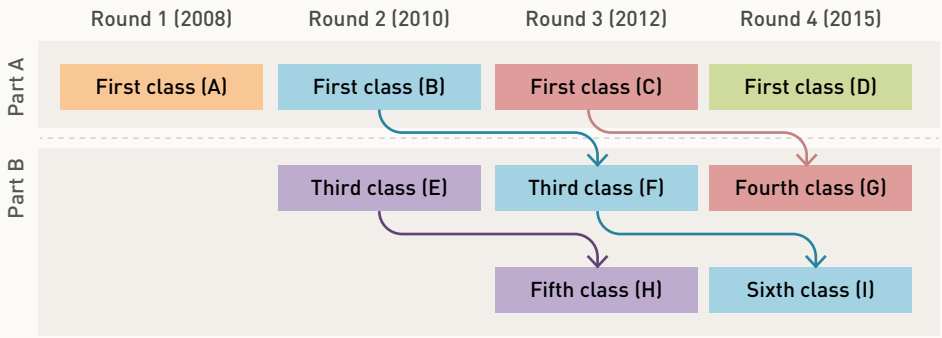
Class	Age range
First Class	6-7 years
Third Class	8-9 years
Fourth Class	9-10 years
Fifth Class	10-11 years
Sixth Class	11-13 years

Cross-sectional analyses (i.e. data collected at one point in time) showed in this report are split into two (Figure 1):

- **Part A:** First class children who participated in Round 1 (2008), Round 2 (2010), Round 3 (2012) and Round 4 (2015).
- **Part B:** Children ≥8 years in Third class in Round 2 (2010), in Third class and Fifth class in Round 3 (2012) and in Fourth and Sixth class in Round 4 (2015) with only the typical ages for each class included in the analyses (Table 2).

Figure 1

Diagram displaying data collection rounds, classes and analyses performed as presented in the current report.

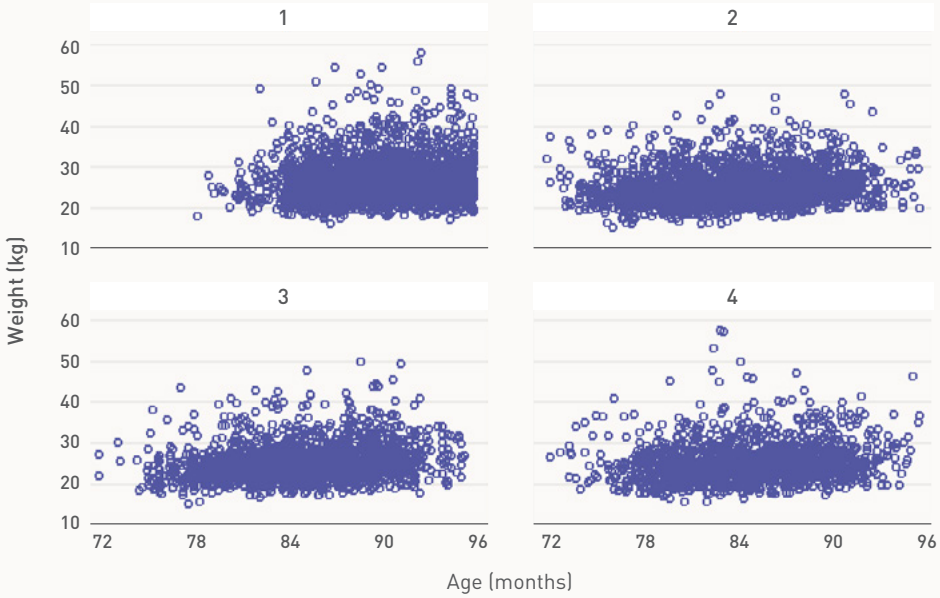


Part A analyses involve data collected in children attending First class aged 6.0-7.9 years in Round 1, Round 2, Round 3 and Round 4 (A, B, C and D in Figure 1). Using a unique identifier longitudinal (cohort) data were also available, in which the same children were measured more than once over the years, i.e. a cohort of children measured once in Round 2 in First class, again two years later when in Third class and three years later in Round 4 in Sixth class (B, F and I in Figure 1), a second cohort of children measured once in Round 2 in Third class and 2 years later in Fifth class (E and H in Figure 1), and a third cohort of children measured once in Round 3 in First class and again three years later in Round 4 in Fourth class (C and G in Figure 1). Part B analyses included data on all children aged ≥8.0 years in Third class in Round 2 (E in Figure 1), in Third and Fifth class in Round 3 (F and H in Figure 1), and in Fourth and Sixth class in Round 4 (G and I in Figure 1). No longitudinal analyses were conducted with this sample, but cross-sectional analyses. Therefore, children with more than one measurement were identified and only the most recent available measurement was included in the analyses, i.e. Fifth class in Round 3 (H in Figure 1), and Fourth and Sixth class in Round 4 (G and I in Figure 1).

When analysing the data, no adjustment for confounding variables was performed except for First class children analyses on actual weight, height, waist circumference and BMI data in which the analyses were adjusted for age. This is because the age-distribution in Round 1 (2008) differs from Rounds 2 (2010), 3 (2012) and Round 4 (2015) (Figure 2). Since measurements in Round 1 took place in summer, median age is higher (7.5 years) as compared with Round 2 (median age 7.0 years), Round 3 (median age 7.1 years) and Round 4 (median age 7.1 years).

Figure 2

Age distribution (in months) according to weight measurements for Round 1 (2008; panel 1), Round 2 (2010; panel 2), Round 3 (2012; panel 3) and Round 4 (2015; panel 4).



In Part A, data are presented and tested for differences among rounds in weight, height, waist circumference and BMI in First class children. Analysis of covariance (ANCOVA) was used to assess a linear trend across Round 1 (2008), Round 2 (2010), Round 3 (2012) and Round 4 in First class 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. Differences and a linear trend in the prevalence of overweight and obesity across different rounds was evaluated, using IOTF cut-off points as defined earlier. To determine a significant difference, Pearson's chi-squared tests were used. Pearson's chi-squared tests, adjusted for age, were used to assess trends. Weight, waist circumference and BMI were non-normally distributed and were therefore transformed to attain normality and their transformed values were used for the comparisons between rounds.

As already described, Part B shows measurements on weight, height, waist circumference and BMI in children aged ≥8.0 years taken in Rounds 2, 3 and 4. Data are presented separately by round and class. Weight, waist circumference and BMI were non-normally distributed; therefore non-parametric tests were applied to evaluate differences between sexes. Also, prevalence of overweight and obesity using IOTF categories is displayed for each round and class evaluated including subgroup analyses by sex, urban/rural schools and disadvantaged/non-disadvantaged schools. Pearson's chi-squared tests were used to evaluate differences between groups.

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%. No adjustments were conducted at this stage for the cluster-sampling procedure.

In the current report, firstly, study characteristics are described which include the children's participation rates and age distribution. Subsequently, Part A presents the cross-sectional analyses on First class children and Part B focuses on the results of the cross-sectional analyses on children ≥8 years old. No results on the longitudinal data are presented in this report.

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" (30). 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) (31).

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 into account of the issue of small schools in the Republic of Ireland (22).

In 2010, 2012 and 2015, 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 3). School response rates in Rounds 2 and 3 were similar and very high. Schools participation in Round 4 was lower as compared with the other rounds, but still high. Lack of time, busy period or too many other commitments, among others, were the main reasons why schools declined to take part in the study.

Table 3

Schools response rate in Rounds 2, 3 and 4.

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
Round 4	Nov 2015-Feb 2016	First	116/162	71.6
		Fourth and Sixth	117/166	70.5

**From this point onwards referred to as R2 (2010), R3 (2012) and R4 (2015), respectively*

Urban and rural schools

Schools response rates according to school location, i.e. urban or rural, for Rounds 2, 3 and 4 are presented in Table 4. Response rates were similar in Round 2 among urban and rural schools; however, rural schools had higher participation rates compared to urban schools in Round 3 and Round 4. Participation rates in Round 4 fell among both types of schools.

Table 4

Response rate of urban vs rural schools

Round*	School type	Response rate	
		n	%
R2 (2010)	Urban schools	120/148	81.1
	Rural schools	32/40	80.0
R3 (2012)	Urban schools	125/155	80.7
	Rural schools	34/40	85.0
R4 (2015)	Urban schools	108/153	70.6
	Rural schools	30/40	75.0

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. In Round 4, disadvantaged schools had higher participation as compared to previous rounds, while the participation rate among non-disadvantaged schools was the lowest (Table 5).

Table 5

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
R4 (2015)	Disadvantaged	26/26	100.0
	Other schools	112/167	67.1

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), during Round 3 (2012) 159 schools (including junior and senior schools) and during Round 4 (2015) 138 schools (including junior and senior schools). Over the four rounds, data of in total 17,145 examinations are available.

Table 6

Participation rates and parental consent

Round	Class	Examined		Parents refused		Absent	
		n	%	n	%	n	%
R1 (2008)	First	2635	72.2	850	23.3	161	4.4
R2 (2010)	First	2016	65.0	1002	32.3	111	3.6
	Third	2016	63.8	1028	32.5	114	3.6
R3 (2012)	First	1753	55.6	1261	39.9	181	5.7
	Third	1945	62.5	1004	32.2	165	5.3
	Fifth	1903	61.1	1023	32.8	188	6.0
R4 (2015)	First	1531	56.6	1030	38.1	142	5.3
	Fourth	1647	62.7	874	33.3	122	4.6
	Sixth	1731	64.0	869	32.1	125	4.6

Over time, numbers of children in First class being examined decreased (Table 6). The participation rate of First class children in Round 4 slightly increased as compared with Round 3. Participation rates among older children remained similar across rounds. Children in Sixth class in Round 4 showed the highest response rate (64.0%). The percentage of parents who refused for their children in First class to take part in the study increased. It was still high in Round 4 (38.1%), but lower than in Round 3 (39.9%). For children ≥8 years old, the percentage of parents who refused to take part in the study remained similar across rounds and ranged from 32.1% for Sixth class in 2015 to 33.3% in Fourth class in 2015. Children being absent on the day of the measurement was very low ranging from 3.6% in First and Third class in 2010 to 6.0% in Fifth class in 2012.

Table 7

Participation rates among First class children by sex, urban and rural schools, and disadvantaged and non-disadvantaged schools.

	R1 (2008)		R2 (2010)		R3 (2012)		R4 (2015)	
	n	%	n	%	n	%	n	%
Boys	1226	70.1	969	64.0	867	56.3	737	54.9
Girls	1409	74.1	1047	65.9	886	54.8	794	58.3
Urban schools	2168	72.4	1664	64.7	1446	54.9	1270	56.3
Rural schools	467	71.2	352	66.5	307	58.6	261	58.0
Other schools	2405	72.5	1877	66.2	1589	56.9	1382	58.5
Disadvantaged schools	230	69.5	139	52.5	164	45.1	149	43.4

Focusing on participation rates among First class children (Table 7), a drop in the response rate was observed over time in both boys and girls, with participation remaining similar between sexes in the same round. Response rates declined over time in all types of schools. Participation equally dropped in urban and rural schools and response rates were quite similar in both types of schools within each round. Overall, response rate was slightly higher among rural schools, except for Round 1 were children in urban schools showed higher participation than those attending schools in rural areas. Lower participation rates were observed across rounds in both disadvantaged and non-disadvantaged schools, although the decline was more pronounced in children attending disadvantaged schools, from 69.5% in Round 1 to 43.4% in Round 4.

Profile of participants

The age distribution of all the children measured in the four rounds is shown below in Table 8. Only the data on those children aged 6-7 years old were analysed within the First class analyses. In the cross-sectional analyses conducted among children ≥8 years old, children in Third class (Round 2), Third and Fifth class (Round 3) and Fourth and Sixth class (Round 4) aged 8 years or older were included in the analyses.

Table 8

Age distribution of the children in the study (with the target age groups highlighted).

Class	Age (yr)	Round 1 (2008)				Round 2 (2010)				Round 3 (2012)				Round 4 (2015)			
		Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
First	5	1	0.1	0	0	4	0.4	9	0.9	2	0.2	4	0.4	3	0.4	1	0.1
	6	29	2.3	32	2.3	440	44.5	552	53.5	342	40.1	371	42.6	273	37.4	353	44.5
	7	1129	90.1	1286	93.0	533	54.0	463	44.9	501	58.7	490	56.2	448	61.4	433	54.6
	8	94	7.5	65	4.7	11	1.1	8	0.7	9	1.0	7	0.8	6	0.8	6	0.8
	Total	**1253**		**1383**		**988**		**1032**		**854**		**872**		**730**		**793**	
Third	7					8	0.9	7	0.7	4	0.5	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				
	Total					**938**		**1068**		**907**		**1038**					
Fourth	8													3	0.4	4	0.4
	9													297	40.2	381	42.0
	10													422	57.1	517	57.0
	11													17	2.3	5	0.6
	Total													**739**		**907**	
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				
	Total									**902**		**998**					
Sixth	10													5	0.6	4	0.4
	11													329	41.0	454	49.1
	12													456	56.8	459	49.6
	13													13	1.6	8	0.9
	Total													**803**		**925**	

Results

Part A: Cross-sectional analyses First class children

The results of the comparisons of anthropometric data for First class children are shown in Table 9.

Table 9

Descriptives and differences over time of age, weight, height, waist circumference and body mass index in First class children.

	Round	n	median	P25-P75	p-value for trend[a]
Age (years)	All	7663	7.2	6.9-7.5	
	R1	2458	7.5	7.3-7.7	<0.001*
	R2	1990	7.0	6.7-7.3	
	R3	1708	7.1	6.8-7.4	
	R4	1507	7.1	6.8-7.3	
Age (months)	All	7663	86.4	82.2-89.9	
	R1	2458	90.0	87.0-92.8	<0.001*
	R2	1990	84.0	80.5-87.4	
	R3	1708	85.1	82.0-88.3	
	R4	1507	85.0	81.9-88.0	
Weight (kg)	All	7652	25.0	22.6-28.0	
	R1	2455	26.0	23.5-29.1	<0.001*
	R2	1984	24.7	22.4-27.5	
	R3	1707	24.6	22.3-27.4	
	R4	1506	24.6	22.2-27.4	
Height (cm)	All	7651	124.0	120.1-127.9	
	R1	2454	125.4	121.6-129.3	0.972
	R2	1983	122.8	119.2-126.8	
	R3	1708	123.6	119.6-127.1	
	R4	1506	123.6	119.8-127.4	
WC (cm)	All	7647	56.3	53.5-59.9	
	R1	2452	57.1	54.4-60.6	<0.001*
	R2	1982	56.3	53.5-60.0	
	R3	1708	55.5	52.8-58.9	
	R4	1505	56.0	53.2-59.5	
Body mass index (kg/m^2)	All	7650	16.3	15.3-17.6	
	R1	2454	16.4	15.5-17.9	<0.001*
	R2	1983	16.3	15.3-17.6	
	R3	1707	16.2	15.3-17.4	
	R4	1506	16.0	15.1-17.3	

*[a]age-adjusted for weight, height, waist circumference and body mass index. *p<0.05*
WC - waist circumference

A small but statistically significant trend was observed over time for weight, waist circumference and BMI. No statistically significant trend was observed for height. Overall, First class children in Round 1 were older, taller, heavier and had higher waist circumference and BMI, which could be explained by the fact that they were also older as compared with First class children measured in the other three rounds (Round 2, Round 3 and Round 4). Without considering Round 1, weight remained quite stable among First class children in Rounds 2, 3 and 4 and children in Round 2 were slightly smaller than those measured in Round 3 and Round 4. First class children in Round 3 had the lowest waist circumference (55.5 cm), followed by children in Round 4 and Round 2 with a median waist circumference of 56.0 cm and of 56.3 cm, respectively. A significant small but linear drop in median BMI was observed across rounds ranging from 16.4 in Round 1 to 16.0 Round 4.

Anthropometric data were further described considering children age in months. Results are shown in Table 10 split into 6-month categories: 72-77 months (6.00-6.49 years), 78-83 months (6.50-6.99 years), 84-89 months (7.00-7.49) and 90-95 months (7.50-7.99).

Table 10

Descriptives and differences over time of weight, height, waist circumference and body mass index in First class children over 6-month periods of age.

	Round	72-77 months				78-83 months				84-89 months				90-95 months			
		n	median	P25-P75	p-value[a]	n	median	P25-P75	p-value[a]	n	median	P25-P75	p-value[a]	n	median	P25-P75	p-value[a]
Weight (kg)	All	314	23.7	21.2-26.2		2030	24.0	21.9-26.7		3386	25.2	22.8-28.1		1862	26.2	23.7-29.5	
	R1	-	-	-	-	91	24.9	22.4-28.0		1120	25.7	23.2-28.6		1244	26.3	23.8-29.7	
	R2	204	23.8	21.3-26.2		784	24.2	22.1-26.8	0.005*	802	25.1	22.7-28.0	0.000*	194	25.8	23.4-28.7	0.059
	R3	92	22.9	20.8-25.7	0.901	603	24.0	22.1-26.3		768	24.8	22.5-27.9		244	26.0	23.8-28.7	
	R4	78	24.2	21.2-27.3		552	23.6	21.4-26.8		696	24.8	22.8-27.4		180	25.9	23.2-28.9	
Height (cm)	All	374	120.2	116.6-124.0		2030	121.8	118.3-125.3		3385	124.6	120.9-128.2		1862	126.3	122.5-130.0	
	R1	-	-	-	-	91	123.4	119-126.7		1119	124.8	121.2-128.5		1244	126.3	122.5-130.0	
	R2	204	120.3	117.5-123.9		784	121.6	118.0-125.0	0.674	801	124.2	120.7-128.0	0.427	194	125.2	122.5-129.6	0.973
	R3	92	119.5	114.9-123.7	0.357	603	122.0	118.5-125.2		769	124.2	120.4-127.9		244	126.6	123.0-130.2	
	R4	78	121.6	116.7-124.9		552	121.7	118.3-125.5		696	124.9	121.1-128.5		180	126.5	122.2-129.7	
WC (cm)	All	374	55.7	52.7-58.7		2028	55.6	52.9-59.4		3383	56.4	53.6-59.9		1862	57.1	54.4-60.6	
	R1	-	-	-	-	91	56.9	54.0-60.7		1117	56.9	54.1-60.3		1244	57.4	54.6-61.1	
	R2	204	55.8	53.1-58.8		783	55.9	60.2-53.2	0.004*	801	56.6	53.6-59.9	0.000*	194	56.8	54.2-60.5	0.001*
	R3	92	54.9	51.6-58.0	0.958	603	55.3	52.7-58.3		769	55.6	52.8-59.2		244	56.3	53.5-59.8	
	R4	78	56.1	52.8-60.6		551	55.5	52.7-59.4		696	56.1	53.8-59.5		180	56.9	53.8-60.0	
Body mass index (kg/m^2)	All	374	16.3	15.5-17.5		2030	16.2	15.2-17.4		3384	16.2	15.3-17.5		1862	16.4	15.4-17.9	
	R1	-	-	-	-	91	16.5	15.4-18.2		1119	16.4	15.4-17.8		1244	16.5	15.5-18.0	
	R2	204	16.4	15.5-17.5		784	16.3	15.3-17.6	0.000*	801	16.2	15.3-17.6	0.000*	194	16.4	15.3-17.6	0.006*
	R3	92	16.2	15.4-17.5	0.759	603	16.1	15.3-17.4		768	16.2	15.2-17.4		244	16.2	15.3-17.5	
	R4	78	16.2	15.6-17.6		552	16.0	14.9-17.2		696	16.0	15.1-17.1		180	16.2	15.3-17.8	

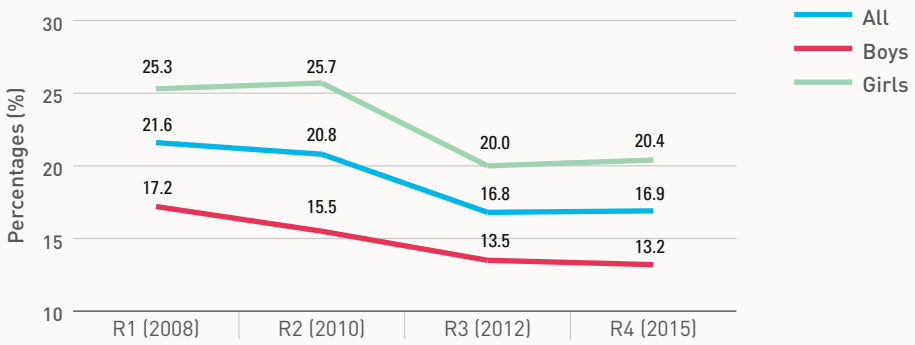
*[a]p-value for trend. *p<0.05. 72-77 months=6.00-6.49 years; 78-83 months=6.50-6.99 years; 84-89 months=7.00-7.49 years; 90-95 months=7.50-7.99; WC - waist circumference.*

Overall, height remained stable across rounds and age categories with no significant trends over time (Table 10). No significant changes in weight occurred across rounds among children aged 72-77 months and 90-95 months; a slight but significant decrease occurred in children aged 78-83 months and a stabilisation was observed in 84-89 months children. A significant trend across rounds was observed for waist circumference, except for those aged 72-77 months. Data showed a small decrease in waist circumference among children aged 78-83 months, and a tendency towards stabilisation seemed to be present in 84-89 months and 90-95 months children. A significant decrease in BMI was observed across rounds in 78-73 months, 84-89 months and 90-95 months children. These results suggest a stabilisation more than a real drop in BMI rates. In this sense, results should be interpreted with caution as participation rates have also dropped since Round 1 – 72.1% in Round 1 to 56.6% in Round 4. However, it cannot be precluded that the observed decrease in BMI is explained by the lower participation rates rather than a real drop in BMI among First class children.

Figures 3-5 present combined prevalence of overweight and obesity among First class children using IOTF cut-offs points.

Figure 3

Differences over time in overweight and obesity prevalence (categorised using IOTF standards) for First class boys and girls.



Overall, a significant inverse trend was observed in First class for the prevalence of overweight and obesity (p-value for trend <0.001). Similarly, overweight and obesity prevalence significantly decreased among both boys and girls in First class (p-value for trend =0.011 in boys, p-value for trend <0.001 in girls). The prevalence of overweight and obesity was significantly higher (p-value <0.001) in girls as compared with boys across all rounds.

The prevalence of overweight and obesity among First class children stratified by urban and rural schools (Figure 4) and by disadvantaged schools (Figure 5) is shown below.

Figure 4

Comparisons of overweight and obesity prevalence (categorised using IOTF standards) by urban and rural schools for First class children.

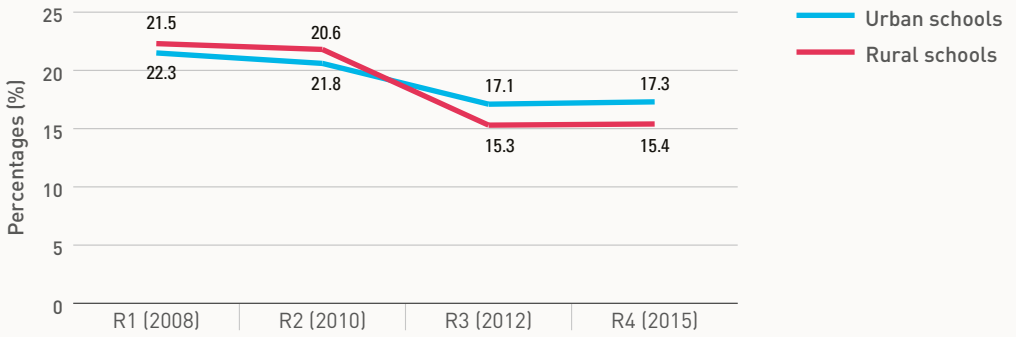
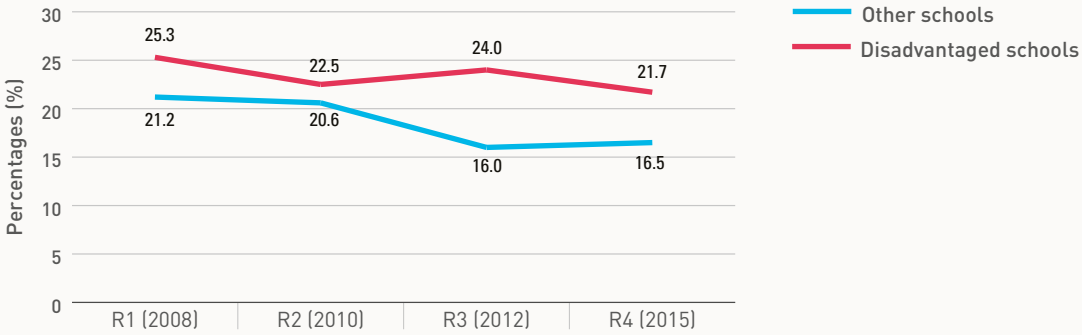


Figure 5

Comparisons of overweight and obesity prevalence (categorised using IOTF standards) by disadvantaged schools for First class children.



Significant inverse trends for overweight (including obesity) were observed for both urban and rural schools (p-value for trend <0.001 in urban schools, p-value for trend=0.002 in rural schools) and non-disadvantaged schools (p-value for trend <0.001) towards a stabilisation of overweight and obesity rates. No significant trend (p>0.05) was observed across rounds for disadvantaged schools, although the prevalence of overweight and obesity among First class children in Round 4 was the lowest observed so far, coupled with a drop in participation rates in children attending these schools. There were no significant differences (p>0.05) in the prevalence of overweight and obesity between either urban and schools or disadvantaged and non-disadvantaged schools. However, overweight and obesity prevalence remains higher among disadvantaged schools in comparison to non-disadvantaged schools and the gap between both types of schools is still present. This gap was more marked in Round 3 (2012).

Part B: Cross-sectional analyses children ≥8 years old

Age distribution among children aged 8 years and older included in these analyses can be seen in Table 11, separately for each round and class.

Table 11

Age distribution of children ≥8 years old by round and class included in the analyses.

Age category (yr)	Round 2		Round 3				Round 4				All rounds	
	Third class		Third class		Fifth class		Fourth class		Sixth class			
	n	%	n	%	n	%	n	%	n	%	n	%
8	616	52.5	512	43.2	-	-	-	-	-	-	1128	14.9
9	558	47.5	672	56.8	-	-	614	38.0	-	-	1844	24.4
10	-	-	-	-	770	41.2	1000	62.0	-	-	1770	23.4
11	-	-	-	-	1098	58.8	-	-	706	41.0	1804	23.9
≥12	-	-	-	-	-	-	-	-	1014	59.0	1014	13.4
Total	**1174**	**100**	**1184**	**100**	**1868**	**100**	**1614**	**100**	**1720**	**100**	**7560**	**100**

As for First class children, descriptive analyses split by round and class are shown in Tables 12, 13 and 14 for children aged 8 years and older who participated in Rounds 2, 3 and 4.

Table 12

Descriptive analyses of age, weight, height, waist circumference and body mass index among children ≥8 years old in Third class in Round 2 (2010).

	Round	Class	All			Boys			Girls			p-value[a]
			n	median	P25-P75	n	median	P25-P75	n	median	P25-P75	
Age (years)	R2	Third	1174	9.0	8.7-9.3	524	9.0	8.7-9.3	650	8.9	8.7-9.2	0.001*
Weight (kg)	R2	Third	1173	31.4	27.8-36.4	523	31.7	28.2-36.5	650	31.2	27.5-36.4	0.493
Height (cm)	R2	Third	1173	134.4	130.6-138.9	523	134.9	131.4-139.5	650	133.8	130.0-138.3	0.001*
WC (cm)	R2	Third	1173	60.5	56.8-66.2	523	60.3	57.0-65.7	650	60.9	56.5-66.8	0.902
BMI (kg/m²)	R2	Third	1173	17.4	16.0-19.3	523	17.2	16.0-18.9	650	17.5	16.0-19.5	0.091

*[a]Mann-Whitney test. *p<0.05. WC - waist circumference*

Table 13

Descriptive analyses of age, weight, height, waist circumference and body mass index among children ≥8 years old in Third class and Fifth class in Round 3 (2012).

	Round	Class	All			Boys			Girls			p-value[a]
			n	median	P25-P75	n	median	P25-P75	n	median	P25-P75	
Age (years)	R3	Third	1184	9.1	8.8-9.4	566	9.2	8.8-9.4	618	9.0	8.7-9.3	<0.001*
		Fifth	1868	11.1	10.8-11.3	879	11.1	10.8-11.4	989	11.1	10.8-11.3	<0.001*
Weight (kg)	R3	Third	1184	31.3	27.9-35.8	566	31.5	28.1-36.1	618	31.0	27.6-35.5	0.211
		Fifth	1866	38.8	34.1-45.3	878	38.6	34.3-44.5	988	38.9	34.0-45.8	0.522
Height (cm)	R3	Third	1184	134.9	130.8-138.9	566	135.5	131.5-139.5	618	134.4	130.0-138.4	<0.001*
		Fifth	1867	146.2	141.7-150.9	878	146.4	142.1-150.6	989	146.0	141.4-151.2	0.640
WC (cm)	R3	Third	1182	60.0	56.2-65.0	566	60.3	56.6-64.8	616	59.7	55.7-65.2	0.203
		Fifth	1864	63.8	54.9-69.8	876	63.8	60.1-69.4	988	63.8	58.8-70.0	0.058
BMI (kg/m²)	R3	Third	1184	17.2	15.9-19.1	566	17.2	15.9-18.9	618	17.3	15.9-19.3	0.515
		Fifth	1866	18.1	16.5-20.3	878	18.1	16.6-20.0	988	18.1	16.4-20.6	0.442

*[a]Mann-Whitney test. *p<0.05. WC - waist circumference*

Table 14

Descriptive analyses of age, weight, height, waist circumference and body mass index among children ≥8 years old in Fourth class and in Sixth class in Round 4 (2015).

	Round	Class	All			Boys			Girls			p-value[a]
			n	median	P25-P75	n	median	P25-P75	n	median	P25-P75	
Age (years)	R4	Fourth	1614	10.1	9.8-10.3	718	10.1	9.8-10.4	896	10.1	9.8-10.3	0.074
		Sixth	1720	12.1	11.8-12.3	797	12.1	11.8-12.4	923	12.0	11.7-12.3	<0.001*
Weight (kg)	R4	Fourth	1612	34.2	30.6-39.1	717	33.9	30.6-38.3	895	34.6	30.4-40.1	0.087
		Sixth	1717	43.2	37.9-50.5	796	42.3	37.2-49.2	921	44.2	38.4-51.6	<0.001*
Height (cm)	R4	Fourth	1612	140.2	136.2-144.6	717	140.7	136.7-145.2	895	139.6	135.7-144.3	0.002*
		Sixth	1716	152.7	147.6-157.5	796	152.3	147.4-156.9	920	152.9	148.0-158.0	0.175
WC (cm)	R4	Fourth	1610	61.2	57.6-66.1	716	61.2	57.9-65.5	894	61.2	57.4-66.8	0.787
		Sixth	1717	65.2	61.2-71.4	795	65.5	61.6-71.7	922	64.8	60.5-71.3	<0.001*
BMI (kg/m^2)	R4	Fourth	1612	17.3	16.0-19.2	717	17.1	16.0-18.7	895	17.6	16.1-19.8	<0.001*
		Sixth	1715	18.5	16.9-20.8	796	18.2	16.7-20.2	919	18.8	17.1-21.5	<0.001*

[a]*Mann-Whitney test. *p<0.05. WC - waist circumference*

Overall, descriptors of anthropometric variables showed an increase in their values in parallel with increasing age suggesting linear growth among children (Tables 12, 13 and 14). Children were heavier and taller with waist circumference and BMI also increasing with age, reflecting a normal growing pattern. Differences in anthropometric variables between boys and girls are also shown for children within the same class. There were no significant differences in weight between sexes, except for Sixth class children with girls being heavier than boys (p<0.001). Overall, boys were taller than girls, with significant differences between Third class children in Round 2 (p=0.017) and Round 3 (p<0.001) and Fourth class (p=0.030) in Round 4. Waist circumference was similar between sexes; only boys in Sixth class had significantly (p<0.001) higher waist circumference than girls. As for BMI, girls in Fourth class (p<0.001) and Sixth class (p<0.001) showed significantly higher values of BMI than boys whereas no differences were observed between boys and girls in the other classes. However, these significant differences might not be relevant from a clinical point of view.

Figures 6-9 show individual anthropometric variables by round separately by sex.

Figure 6

Change in weight with age for children ≥8 years.

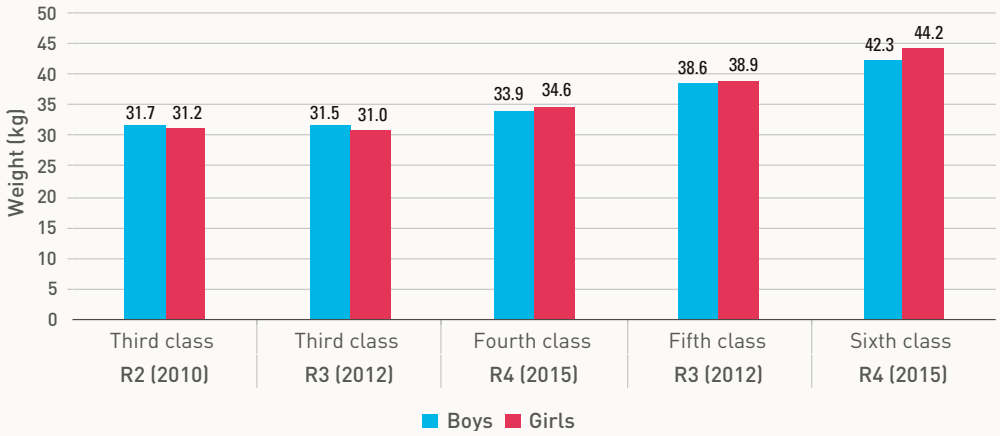


Figure 7

Change in height with age for children ≥8 years.

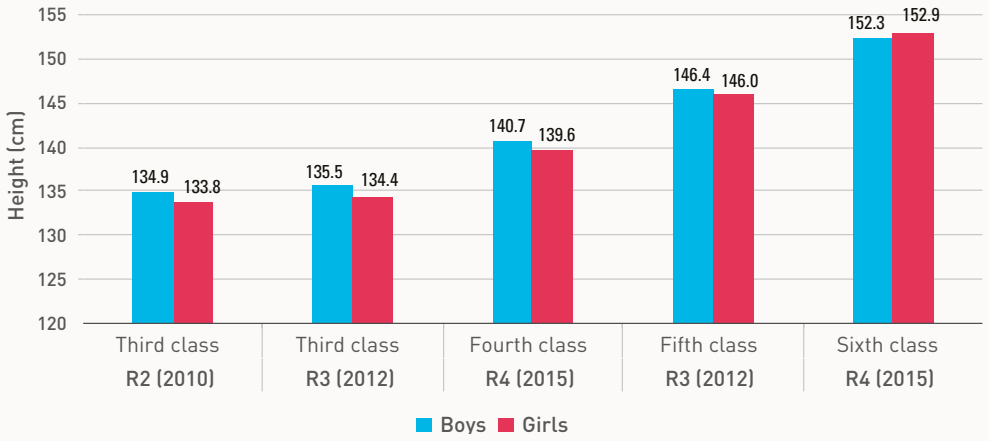


Figure 8

Change in waist circumference with age for children ≥8 years.

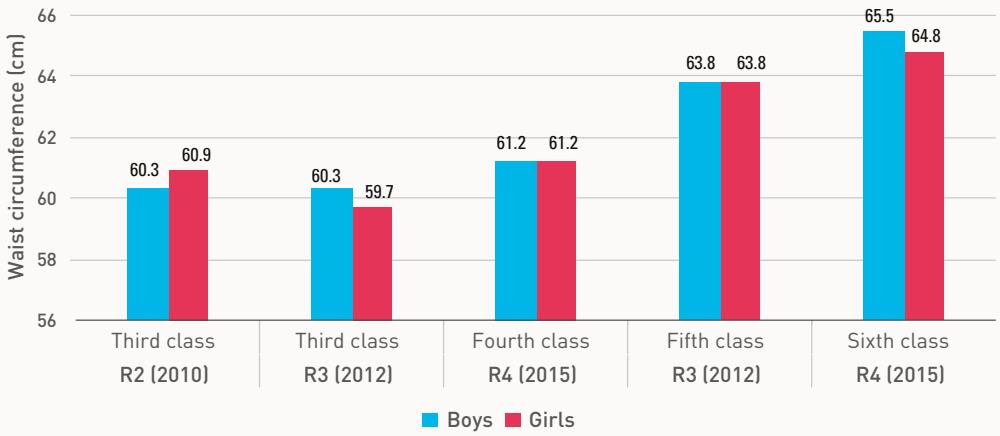


Figure 9

Change in body mass index with age for children ≥8 years.

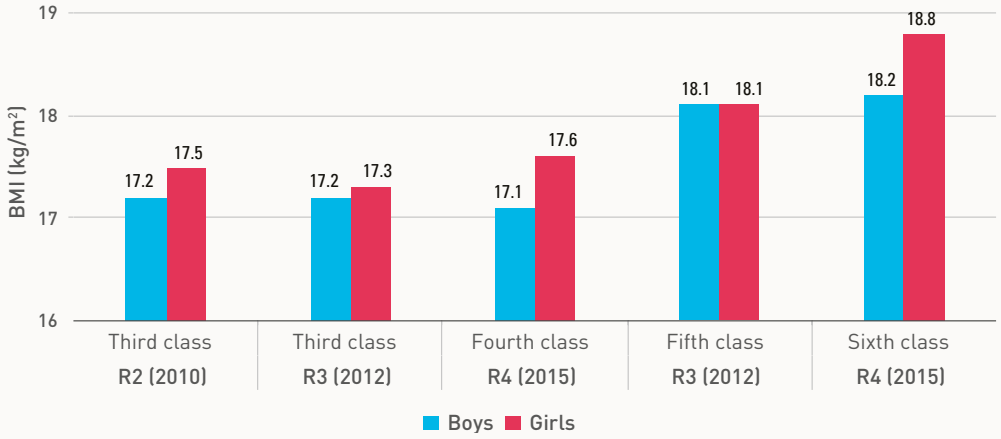


Figure 6 shows that boys were heavier than girls at younger ages. This tendency was reversed as children grew up with girls steadily becoming heavier than boys, being this difference more marked (and significant) among Sixth class children. Boys remained taller than girls across classes (Figure 7). However, girls in Sixth class children were taller than boys, and although not statistically significant (p>0.05), it could be an indicator of the initiation of the pubertal development in girls, which tends to occur earlier than in boys.

There was no clear pattern in terms of waist circumference and children's age (Figure 8). Overall, girls had higher BMI than boys in all classes. A more marked and statistically significant difference was observed between boys and girls in Fourth class and Sixth class in Round 4.

Figure 10

Prevalence of overweight and obesity (categorised using IOTF standards) by class among children ≥8 years.

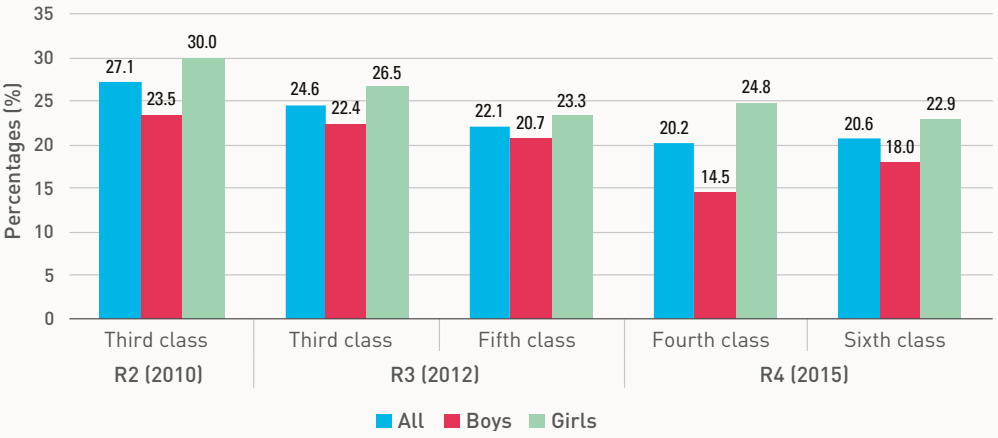


Figure 10 presents combined prevalence of overweight and obesity among children aged 8 years and older using IOTF cut-offs points. A higher proportion of girls was overweight and obese, with significant differences (p<0.001) between sexes in the prevalence of overweight and obesity in Third class in Round 2 (p=0.013), Fourth class (p<0.001) and Sixth class (p=0.013) in Round 4. No significant differences were observed between boys and girls in classes examined in Round 3. A stabilisation in terms of overweight and obesity rates seems to be occurring in both sexes.

Figures 11-12 show the prevalence of overweight and obesity among children ≥8 years old stratified by urban and rural schools (Figure 11) and by disadvantaged schools and other schools (Figure 12).

Figure 11

Comparisons of overweight and obesity prevalence (categorised using IOTF standards) by class separately for urban and rural schools in children ≥8 years.

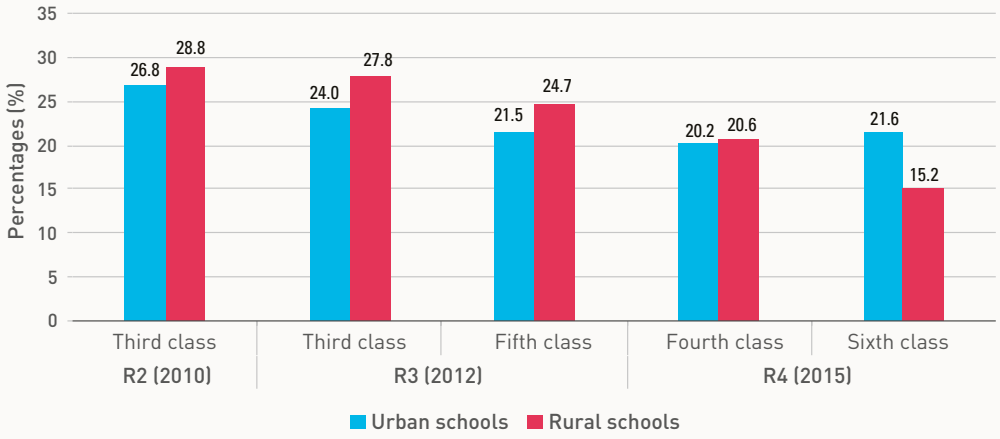
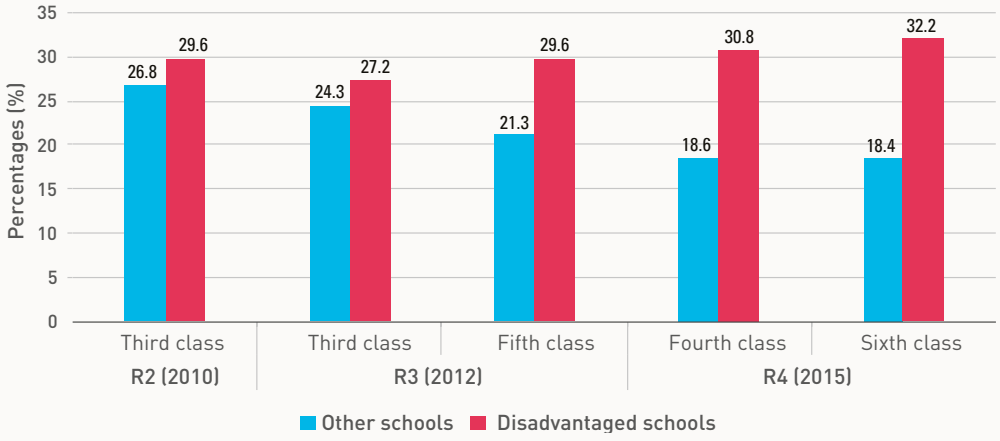


Figure 12

Comparisons of overweight and obesity prevalence (categorised using IOTF standards) by class separately for disadvantaged schools and other schools in children ≥8 years.



No significant differences were observed between urban and rural schools in terms of overweight and obesity prevalence, except among children in Sixth class (p=0.019) in Round 4. Overweight and obesity could be stabilising in urban schools, whereas a drop seems to be taking place with age in rural schools. Disadvantaged schools had higher prevalence of overweight and obesity in comparison with other schools. Children in Fifth class (p=0.011) in Round 3 and in Fourth class (p<0.001) and Sixth class (p<0.001) in Round 4 attending disadvantaged schools showed significantly higher overweight and obesity rates than children in other schools. These results show that the existing gap in overweight and obesity rates between disadvantaged schools and other schools becomes wider as children become older. Furthermore, while the prevalence of overweight and obesity in children attending non-disadvantaged schools could be stabilising across rounds, overweight and obesity rates among children older than 8 years seem to be increasing with age in disadvantaged schools.

Conclusion

Participation rates

A large dataset on anthropometric variables is currently available for a representative sample of Irish primary school children examined across the four COSI rounds. Overall, the participation rate among schools has fallen over time, mainly among non-disadvantaged schools. In contrast, all the disadvantaged schools that were invited to take part in the study in Round 4 agreed to participate. Participation rates among First class children have also decreased across rounds, with the highest participation rate being observed in Round 1 and the lowest in Round 3. Nevertheless, it has slightly increased among First class children in Round 4. The participation rate among older children has remained similar over waves.

The main reason for children not participating in the survey is the lack of consent from their parents. Although no information has been collected on the specific reasons why parents do not allow their children to be measured, we have speculated that, firstly, since obesity is a sensitive topic in Ireland, parents may feel judged when their children are measured and, as a result, they do not give consent for their children to be examined. However, it cannot be precluded that our findings are explained by the fact that overweight and obese children were not fully represented in our sample, rather than a real tendency towards stabilisation of overweight and obesity rates among Irish children, mainly among those in First class. This should be a consideration when interpreting the findings presented in this report.

First class children

First class children measured in Round 1 were older than those measured in subsequent rounds. It is explained by the fact that measurements in Round 1 took place during summer and most of the children had turned 7 years when they were examined. For that reason, analyses were split into smaller age categories, i.e. 6 months, to potentially remove the age effect. This allowed us to observe that a significant time trend towards stabilisation in overweight and obesity rates appears to be occurring in Irish First class children when focusing on those with the same exact age, i.e. 84-89 months (7.00-7.49 years). Hence, date of measurement in relation to birthdate needs to be considered when investigating obesity in 7-year-old children as a 6-month age difference could represent a large gap in growth.

Girls were significantly more overweight and obese than boys across waves. Significant inverse trends for overweight (including obesity) were observed for First class children in urban, rural and non-disadvantaged schools, whereas no significant trend across rounds was observed for disadvantaged schools. Overweight and obesity rates for Round 4 in disadvantaged schools were the lowest as compared with previous rounds; however, they still remain higher in comparison with other schools and the gap between both types of schools is still present. Although participation rates declined among all types of schools over time, it was markedly higher among children attending disadvantaged schools.

Children ≥8 years old

Findings showed linear normal growth among children aged ≥8 years. Older girls (12-13 years) had higher weight and height than boys, which could be an indicator of the onset of the pubertal development. Overweight and obesity rates are stabilising with age in both sexes and more girls were overweight and obese than boys. Children ≥8 years attending disadvantaged schools had higher rates of overweight and obesity than children in other schools. While the prevalence of overweight and obesity in children attending non-disadvantaged schools could be stabilising with age, overweight and obesity rates among children older than 8 years in disadvantaged schools seem to become higher as they grow up.

To conclude, results showed a significant temporal effect towards the stabilisation of overweight and obesity rates across rounds in Irish First class children. It was not observed for First class children in disadvantaged schools, though. Among children aged ≥8 years, overweight and obesity rates seems to be stabilising as children become older; however, children attending disadvantaged schools show higher prevalence with age. The decline in participation rates over time could be linked to the existence of some degree of participation bias, mainly among the overweight and obese, which could partially explain the observed results.

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

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Role	Name	Institution	Place
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