

# Childhood obesity: the extent of the problem among 6-year-old Irish national school children

D. S. Evans, M. Glacken and D. Goggin

Health Service Executive West, Department of Public Health, Merlin Park Hospital, Galway, Ireland

Accepted for publication 18 August 2010

## Abstract

**Background** Childhood obesity is rapidly increasing worldwide. In Ireland, the number of overweight children has trebled over the last decade. The study aimed to provide an assessment of the prevalence of obesity of 6-year-old children in one region of Ireland.

**Methods** Following training, School Public Health Nurses included the measurement of height and weight as part of the annual 'senior infants' school health check for 5453 6-year-old children in 189 schools between 2004 and 2007. Body mass index (BMI) was calculated using the International Obesity Taskforce cut-off points using ImsGrowth (a Microsoft Excel add-in), which uses a child's exact age. Kendall's Tau b was used to determine the reliability of measurements. Prevalence trends were tested using multinomial logistic regression. Pearson's chi-squared test was utilized to assess the statistical significance of differences in BMI by gender, school year, and to compare with similar other Irish studies.

**Results** Out of the 5453 children measured, 3493 were aged 6 years old. A further 11 were excluded because of incomplete data. Data were analysed for 3482 6-year-old children. Overall, 27% of 6-year-olds were classified as either overweight or obese. A significantly greater proportion of girls are overweight or obese compared with boys (31% compared with 23%). Gender differences have remained relatively stable from 2004–2007. Overall, there have been no significant changes in the level of obesity from 2004–2007. In addition, when comparing with other Irish studies that collected data for 2001/2, there are no significant differences in obesity levels.

**Conclusions** There is a clear need to urgently prioritize the effective management of obesity. Resources should now be targeted towards ensuring government policies in Ireland and elsewhere are implemented.

## Keywords

body mass index, height and weight, obesity, school children

## Correspondence:

David S. Evans, Health Service Executive West, Department of Public Health, Merlin Park Hospital, Galway, Ireland  
E-mail: david.evans@hse.ie

## Introduction

Childhood obesity is rapidly increasing worldwide (Lobstein *et al.* 2004) and is linked to a more sedentary lifestyle, reduced physical activity and an increase in the consumption of high energy foods (Doak *et al.* 2006). It is estimated that one in five children in Europe is overweight, with the number of overweight children rising by 400 000 every year (International Obesity Task

Force 2005). The current rate of childhood obesity across Europe is 10 times greater than that experienced in the 1970s (Branca *et al.* 2007). In Ireland, data from a number of studies suggest that the number of overweight children has trebled over the last decade with the number increasing by 10 000 annually (National Taskforce on Obesity 2005, p. 6).

Childhood obesity is associated with a wide range of medical complications (e.g. orthopaedic complications, metabolic

disturbances, type II diabetes) and psychosocial complications (e.g. low self esteem, underachievement in school, depression, discrimination) (Dietz 1998; Doak *et al.* 2006). Over 60% of children who are overweight by puberty will be overweight in early adulthood (Deshmukh-Taskar *et al.* 2006). This puts them at risk of experiencing the long-term consequences of adult obesity such as cardiovascular disease and type II diabetes (Doak *et al.* 2006).

Prevention has been recognized as the only feasible option to address childhood obesity (Lobstein *et al.* 2004). To ensure policy makers adopt effective preventative measures, it is essential that accurate data are collected to assess the magnitude of the problem and monitor trends over time. Currently however, only 23 countries across the World Health Organisation (WHO) European Region use height and weight measurements to monitor obesity levels in children at a national level (Branca *et al.* 2007). In Ireland, the development of a national surveillance programme (Denyer *et al.* 1999, p. 51) and national database of growth measurements has been recommended (National Taskforce on Obesity 2005, p. 91) but as yet no system for routinely collecting these data has been established. Owing to the absence of a national surveillance programme, the study aimed to provide an assessment of the prevalence of obesity of 6-year-old children in one region of Ireland.

## Method

A standard school health check is undertaken in the Republic of Ireland for all children attending senior infant classes. For the study period, the height and weight measurements for each child were added to this health check. Other classes were not included as these were outside the range of the normal school health programme. All 189 primary schools in County Mayo, Ireland were included in the study. For each school year of the study, all children in senior infant classes that were scheduled for a school health check (February 2005 to June 2008) were included. In 2005, 115 schools had already received a school health check prior to the commencement of the study. As such, the number of schools included in the study for the 2004/5 school year was 74. Consent for children to undertake the routine school health check was received from the parents/guardians of all children included in the study. The height and weight of each child was then measured by a school Public Health Nurse, as part of the health check. To ensure standardized measurement techniques, all five school Public Health Nurses who undertook the measurements received training and adhered to practice guidelines developed

by the study team (Glacken & Evans 2006). The school Public Health Nurses also used standardized equipment (calibrated Tanita solar portable scales and a free standing Leicester portable height metre). Height was measured to the nearest 0.1 cm and weight was measured to the nearest 0.1 kg. In addition, intra-observer variability was measured by repeating every 10th measurement.

The height and weight measurements for each child were entered into a database, along with their name, date of birth, gender and date of examination. Following verification of the data, names were removed from the database and analysis was undertaken anonymously to maintain confidentiality. The process adopted to maintain confidentiality received approval from the National Data Protection Agency.

From the measurements, each child's body mass index (BMI) was calculated using the standard formula and the cut-off points using the LMS method (Cole *et al.* 2007) with *lms-growth* (a Microsoft Excel add-in) that has been developed by Tim Cole (University College London). This calculates a BMI category using the International Obesity Task Force (IOTF) cut-off points for each child based on their exact age. This protocol has been recommended by the WHO EU Growth Surveillance Initiative. Only 6-year-olds were included in the current analysis, to control for age variations in the data, and to facilitate comparisons with other studies. Age six was defined as all children aged 6.0–6.9 years, as recommended by Cole and colleagues (2000).

Microsoft Excel and SPSS V15 (SPSS Ireland Ltd, Dublin, Ireland) were utilized to analyse the data. Kendall's Tau b was used to determine intra-observer agreement. Prevalence trends were tested using multinomial logistic regression with normal weight defined as the reference category, and school year, urban or rural schools, and gender as the predictors. Pearson's chi-squared test was utilized to assess the statistical significance of differences in BMI by gender and urban or rural schools. In addition, Pearson's chi-squared test was undertaken to determine the significance of any differences in BMI between the current study and similar other Irish studies that calculated BMI for 6-year-old children (McMaster *et al.* 2005, Whelton *et al.* 2007a,b). These studies used comparable research methodologies although did differ in terms of the IOTF cut-off points that were used. The current study used age groups of 1 year width and IOTF cut-off point based on exact age. McMaster and colleagues (2005) used age bands of 6 months and IOTF cut-off points for 6-month bands. Whelton and colleagues (2007a,b) used IOTF cut-off points for 6-month bands applied to the mean age of children in the age year.

## Results

### Background profile

A total of 5453 out of 5469 (99.7%) children were measured. Sixteen children were excluded from the study owing to non-attendance ( $n = 5$ ), not being able to stand independently ( $n = 5$ ) and parents not consenting to the examination ( $n = 6$ ). Of the children that were measured, 3493 were aged 6 years old at the time of measurement. A further 11 children were excluded from the analysis owing to incomplete data. Data were analysed for 3482 6-year-old children between 2004 and 2007. Over three-quarters of children (78%) attended rural schools with 22% attending urban schools. Table 1 gives a profile of children by year and gender. Overall, 52% were male and 48% were female.

**Table 1.** Profile of children by year and gender

School year	Male		Female		Total	
	No.	%	No.	%	No.	%
2004	298	52.3	267	47.3	565	16.2
2005	499	51.7	466	48.3	965	27.7
2006	509	52.7	456	47.3	965	27.7
2007	497	50.4	490	49.6	987	28.3
Total	1803	51.8	1679	48.2	3482	100

### Intra-observer agreement

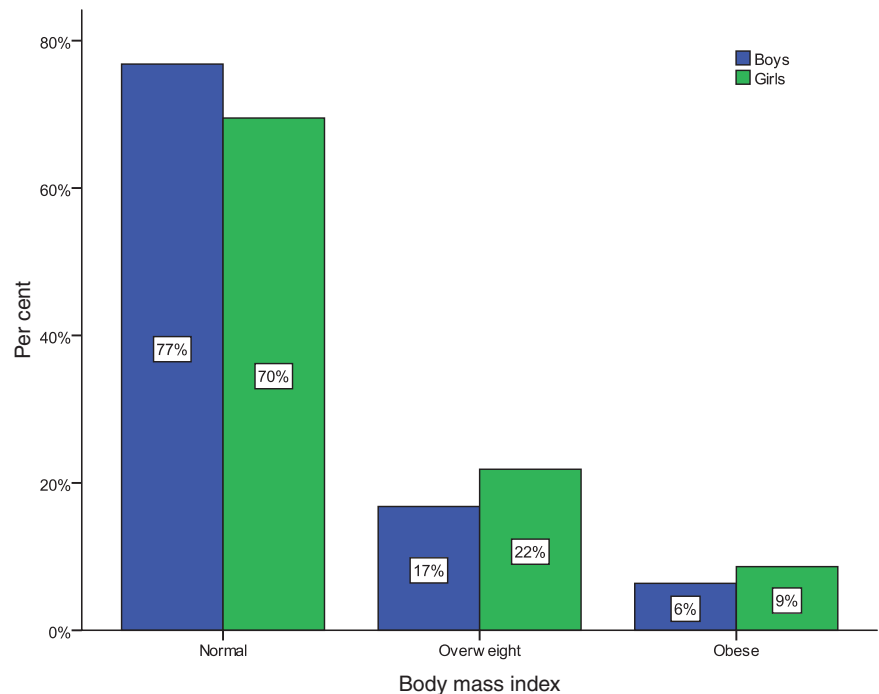
The height of 209 children (6%) was rechecked. The intra-observer agreement was statistically significant (Kendall's Tau  $b = 0.489$ ,  $P = 0.000$ ). Weight was rechecked for 233 children (7%). The intra-observer agreement was also statistically significant (Kendall's Tau  $b = 0.460$ ,  $P = 0.000$ ).

### Body mass index

Of the 3482 children that were measured, 19% were classified as overweight and 8% as obese. Figure 1 shows that a larger proportion of boys were classified as normal (77% compared with 70%), with a larger proportion of girls classified as overweight (22% compared with 17%) or obese (9% compared with 6%). These differences are statistically significant ( $\chi^2 = 23.81$ , d.f. = 2,  $P = 0.000$ ).

### Prevalence trends

Table 2 shows BMI by school year, gender, and urban or rural schools. Although there are fluctuations in the proportion of children that are overweight and obese by school year, multinomial logistic regression revealed that there was no significant overall trend from 2004–2007 ( $P > 0.05$ ). Similarly, there was no significant trend in differences found between children attend-



**Figure 1.** Body mass index 2004–2007 by gender.

**Table 2.** Body mass index by school year, gender, and urban or rural school

School year	Normal		Overweight		Obese	
	No.	%	No.	%	No.	%
Boys						
2004	221	74.2	63	21.1	14	4.7
2005	391	78.4	78	15.6	30	6.0
2006	376	73.9	95	18.6	38	7.4
2007	397	80.0	67	13.4	33	6.6
Total	1385	76.8	303	16.8	115	6.4
Girls						
2004	186	69.7	58	21.7	23	8.6
2005	326	70.0	99	21.2	41	8.8
2006	316	69.0	100	21.8	40	8.7
2007	339	68.6	110	22.3	41	8.3
Total	1167	69.5	367	21.9	145	8.6
Urban						
2004	53	76.8	12	17.4	4	5.8
2005	188	74.9	45	17.9	18	7.2
2006	144	72.0	40	20.0	16	8.0
2007	185	73.7	44	17.5	22	8.8
Total	570	73.9	141	18.3	60	7.8
Rural						
2004	354	71.4	109	22.0	33	6.7
2005	529	74.1	132	18.5	53	7.4
2006	548	71.6	155	20.3	62	8.1
2007	551	74.9	133	18.1	52	7.1
Total	1982	73.1	529	19.5	200	7.4
Total						
2004	407	72.0	121	21.4	37	6.5
2005	717	74.3	177	18.3	71	7.4
2006	692	71.7	195	20.2	78	8.1
2007	736	74.6	177	17.9	74	7.5
Total	2252	73.3	670	19.2	260	7.5

ing urban or rural schools ( $P > 0.05$ ). Comparing boys and girls it can be seen from Table 2 that for each year, a higher proportion of girls are overweight or obese. The proportion of girls overweight or obese was relatively stable from 2004–2007 whereas the level fluctuated for boys. Multinomial logistic regression demonstrated that trends in BMI by gender were statistically significant with females more likely to be overweight (odds ratio = 0.694, CI = 0.585–0.823,  $P = 0.001$ ) and obese (odds ratio = 0.667, CI = 0.516–0.852,  $P = 0.002$ ). For 2004–2007 overall, a significantly higher proportion of girls were overweight or obese (31% compared with 23%;  $\chi^2 = 23.738$ , d.f. = 1,  $P = 0.000$ ).

### Comparison with other Irish Studies

Table 3 compares the BMI results of the current study with two other Irish studies, which collected data for 2001/2. Compared with McMaster and colleagues (2005) (using data col-

**Table 3.** Comparison of body mass index with other studies of 6-year-old children

Gender	Normal		Overweight		Obese	
	No.	%	No.	%	No.	%
Current study (Mayo, Ireland, 2004–2007)*						
Boys	1385	76.8	303	16.8	115	6.4
Girls	1167	69.5	367	21.9	145	8.6
Total	2552	73.3	670	19.2	260	7.5
McMaster <i>et al.</i> (2005) (Leitrim/Cavan, Ireland, 2001/2)†						
Boys	87	75.0	17	14.7	12	10.3
Girls	76	76.0	17	17.0	7	7.0
Total	163	75.5	34	15.7	19	8.8
Whelton <i>et al.</i> (2007a,b) (National Study of Ireland, 2002)‡						
Boys	184	82.1	29	13.0	11	4.9
Girls	108	71.1	33	21.7	11	7.2
Total	292	77.7	62	16.5	22	5.9

\*Age groups of 1 year width and IOTF cut-off point based on exact age.

†Age bands of 6 months and IOTF cut-off points for 6-month age bands.

‡IOTF cut-off points for 6-month bands applied to the mean age of children in the age year.

IOTF, the International Obesity Task Force.

lected for the 2001/2 academic year), it can be seen that the overall proportion of 6-year-old children which are overweight or obese is 2% higher in the current study (2% lower for boys and 7% higher for girls). These differences are not statistically significant overall ( $\chi^2 = 0.387$ , d.f. = 1,  $P = 0.5338$ ), for boys ( $\chi^2 = 0.201$ , d.f. = 1,  $P = 0.0738$ ), or for girls ( $\chi^2 = 1.891$ , d.f. = 1,  $P = 0.207$ ). Compared with Whelton and colleagues (2007a,b) (using data collected in 2002), it can be seen that the overall proportion of 6-year-old children who are overweight or obese is 5% higher in the current study (5% higher for boys and 2% higher for girls). These differences are not statistically significant overall ( $\chi^2 = 0.387$ , d.f. = 1,  $P = 0.5338$ ), for boys ( $\chi^2 = 0.201$ , d.f. = 1,  $P = 0.0738$ ), or for girls ( $\chi^2 = 1.891$ , d.f. = 1,  $P = 0.207$ ).

### Discussion

The study aimed to provide an assessment of the prevalence of overweight and obesity among 6-year-old Irish school children. It involved measuring the BMI of 3482 6-year-old children in 189 schools between 2004 and 2007 in county Mayo, Ireland. This represents the largest study undertaken of this age group in Ireland and provides a meaningful insight into patterns of overweight and obesity for this age cohort. Using IOTF cut-off points, 27% of 6-year-olds that were measured between 2004

and 2007 were classified as either overweight or obese. This level of prevalence (which is similar to that found in other European countries; e.g. Albertini *et al.* 2007; Stamatakis *et al.* 2010) represents a significant challenge to policy makers. If left unchecked, young children are likely to become overweight and obese in early adulthood, leading to an increased risk of long-term health consequences (Doak *et al.* 2006).

The study has found that there have been no significant changes in the level of obesity between 2004 and 2007. When comparing the study findings with other Irish studies (McMaster *et al.* 2005; Whelton *et al.* 2007a,b) that collected data for 2001/2, there are no significant differences in obesity levels. This pattern is similar to that found by Ogden and colleagues (2008, 2010) in analysing trends in US children and adolescents (aged 2–19) between 1999 and 2006 (Ogden *et al.* 2008) and between 1999 and 2008 (Ogden *et al.* 2010). Sundblom and colleagues (2008) in a study of 10-year-old children in Sweden between 1993 and 2003 did not find any significant overall changes in levels of overweight or obesity. Kipping and colleagues (2008) suggest that the prevalence of obesity in England and the US is levelling off. However, they note that it is too early to know if the peak in obesity levels has been reached. This would also be the case for the current study, particularly as data for a relatively short time period were collected (2004–2007).

A degree of caution is required when making comparisons with other studies, as the application of IOTF cut-off points is not uniform. Kramer and colleagues (2006) for example have shown that using different age intervals for IOTF cut-off points (i.e. using 12-month as opposed to 6-month age intervals) introduces a small but systematic bias in prevalence estimates of overweight and obesity. This highlights the need to standardize the application of IOTF cut-off points in obesity research. Future comparisons will be facilitated by the development of the WHO European Childhood Surveillance Initiative (WHO 2010), which will provide a standardized system of data collection and analysis for children (aged 6–7.9 years) throughout the European region. Ireland has made a commitment to this initiative and it is planned to have an annual or biannual national survey programme in the future.

Although comparisons with other studies are difficult, the results do reinforce the need for obesity policies to be developed and implemented. In Ireland, a policy to tackle obesity was launched in 2005 (National Taskforce on Obesity 2005). It contains over 80 recommendations for action across key sectors (high-level government, education, social and community, health, food, commodities, production and supply, and the physical environment). In addition, the Health Service Executive (2009) in Ireland has recently introduced a Framework for

Action on Obesity. This is adopting a population health approach, which is actively seeking to address the broader determinants of obesity and health inequalities. Both these policy developments will require further review as outcomes are monitored.

The findings show that a significantly greater proportion of girls are overweight or obese compared with boys (31% compared with 23%). These differences have remained relatively stable from 2004–2007. Whelton and colleagues (2007a,b) in a national study for Ireland found a similar pattern (29% for girls compared with 18% for boys). McMaster and colleagues (2005), however, in a study of Leitrim/Cavan in Ireland did not find significant gender differences. In a review of studies of gender and childhood obesity, Wisniewski and Chernauek (2009) have found that gender differences were common, both before and during puberty. Hanafin and colleagues (2008) in a study of Irish school children (aged 9–17 years) found that while 9-year-old girls report similar activity levels, girls aged 10–17 report being less physically active than boys. In a study of 11- to 15-year-old children across 41 countries, Haug and colleagues (2009) found that overweight was negatively associated with breakfast consumption and moderate to vigorous physical activity. Wisniewski and Chernauek (2009) note that boys and girls differ in terms of social, ethnic, genetic and environmental factors. The cause and consequence of obesity is therefore different by gender and may also vary between different countries. This suggests a need for individual countries to develop both generic and gender-specific initiatives to tackle obesity.

Comparisons between urban and rural schools did not reveal any significant differences in the proportion overweight or obese (26.1% for urban schools compared with 26.9% for rural schools). Similar results were found by Booth and colleagues (1999) in a study of children and adolescents in Australia. This contrasts with Malik and Bakir (2007) who found that children in rural areas of the United Arab Emirates had lower levels of overweight and obesity. They suggest that rural areas in the United Arab Emirates have more traditional eating habits which are linked to the Bedouin lifestyle. The current study did not collect data on lifestyle or eating habits. The findings, however, do indicate that lifestyle behaviours may be relatively uniform among the study population both in rural and urban areas.

In terms of reliability, the rechecking of a sample of both height and weight measurements found a significant level of agreement. Standardized measurement techniques and equipment, the use of practice guidelines and a training programme were measures that were put in place to ensure that reliable measurements were obtained. The study has shown that it is

feasible to measure children's height and weight accurately in the school setting.

As the study focused on one geographical region, the results may not be representative for Ireland overall, which does place some limitations on the study. In addition, the data collection period of 4 years meant that it was not possible to undertake a detailed analysis of trend over time. It was only possible to collect a limited amount of socio-demographic data for each child which also limited the depth of analysis that could be undertaken. This demonstrates the need to develop an ongoing monitoring system to record children's height and weight. Despite these limitations, the large sample of 3482 children ensures that a useful insight into childhood obesity can be gained, which does have implications for the development of policy and interventions in Ireland and elsewhere.

In conclusion, the study has shown that over one in four Irish 6-year-old school children were overweight or obese. There is an urgent need to prioritize the effective management of obesity. However, there remains some debate in terms of the best way forward. Haslam and colleagues (2006) note that enough is known about the causes of obesity and its effective treatment and maintain that the barriers to successful management of obesity are political and organizational. Lobstein and colleagues (2004), by contrast, state that effective prevention techniques have proved elusive. They suggest that policies and actions are required at an individual, local and international level; and that this will require multi-agency involvement. Obesity is a complex issue and the best way forward may vary in different countries. Having a policy to tackle obesity will be ineffective unless sufficient resources are allocated to their implementation. Doing nothing is not an option and the specific way forward for each country can be determined once the resources are in place to implement policy.

### Key messages

- Childhood obesity is increasing worldwide. It is essential that accurate data are collected to assess the magnitude of the problem and monitor trends over time.
- Twenty-seven per cent of 6-year-olds in Ireland (county Mayo) were classified as either overweight or obese (31% girls and 23% boys).
- There have been no significant changes in the level of obesity between 2004 and 2007.
- Childhood obesity prevalence in Ireland (county Mayo) is too high and needs addressing.

### Acknowledgements

The authors wish to acknowledge the contribution of all participants, and the School Health Staff in County Mayo who took part in this project. In particular, we would like to thank the School Public Health Nurses (Margaret Collins, Bridie Grogan, Rita Hyland, Mary O. Malley and Nula O. Hora) for undertaking the height and weight measurements. In addition, we would like to thank the Department of Community Nutrition and Dietetics for providing training and validating results; and to Dr Declan Mc Keown and Dr Jacky Jones for advice in terms of data analysis. We would also like to thank Fiona Healy and Claire Dunne for proof reading and assistance throughout the project.

### References

- Albertini, A., Tripodi, A., Fabbri, A., Mattioli, M., Cavrini, G., Cecchetti, R., Dalle Donne, E., Cortesi, C., De Giorgi, S., Contarini, V., Andreotti, L., Veronesi, B., Stefanelli, I. & Di Martino, E. (2007) Prevalence of obesity in 6- and 9-year-old children living in Central-North Italy. Analysis of determinants and indicators of risk of overweight. *Obesity Reviews*, **9**, 4–10. Available at: <http://www3.interscience.wiley.com/journal/119421151/abstract> (abstract) (last accessed 22 April 2010).
- Booth, M. L., Macaskill, P., Lazarus, R. & Baur, L. A. (1999) Sociodemographic distribution of measures of body fatness among children and adolescents in New South Wales, Australia. *International Journal of Obesity*, **23**, 456–462. Available at: <http://www.nature.com/ijo/journal/v23/n5/pdf/0800841a.pdf> (last accessed 23 May 2010).
- Branca, F., Nikogosian, H. & Lobstein, T. (2007) *The Challenge of Obesity in the WHO European Region and the Strategies for Response*. World Health Organisation Europe, Denmark. Available at: <http://www.euro.who.int/document/E90711.pdf> (last accessed 21 December 2009).
- Cole, T. J., Bellizzi, M. C., Flegal, K. M. & Dietz, W. H. (2000) Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*, **320**, 1240–1243. Available at: <http://www.bmj.com/cgi/reprint/320/7244/1240> (last accessed 4 May 2010).
- Cole, T. J., Flegal, K. M., Nicholls, D. & Jackson, A. (2007) Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ*, **335**, 194–197. Available at: <http://www.bmj.com/cgi/reprint/335/7612/194> (last accessed 12 January 2010).
- Denyer, S., Thornton, L. & Pelly, H. (1999) *Best Health for Children-Developing a Partnership with Families, Dublin*. Available at: <http://www.lenus.ie/hse/bitstream/10147/45180/1/6871.pdf> (last accessed 4 January 2010).
- Deshmukh-Taskar, P., Nicklas, T. A., Morales, M., Yang, S.-J., Zakeri, I. & Berenson, G. S. (2006) Tracking of overweight status from childhood to young adulthood: the Bogalusa Heart Study.

- European Journal of Clinical Nutrition*, **60**, 48–57. Available at: <http://www.nature.com/ejcn/journal/v60/n1/abs/1602266a.html> (last accessed 21 December 2009).
- Dietz, W. H. (1998) Health consequences of obesity in youth: childhood predictors of adult disease. *Paediatrics*, **101**, 158–525. Available at: <http://pediatrics.aappublications.org/cgi/content/abstract/101/3/S1/518> (last accessed 21 December 2009).
- Doak, C. M., Visscher, L. S., Renders, C. M. & Seidell, J. C. (2006) The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. *Obesity Reviews*, **7**, 111–136. Available at: <http://www3.interscience.wiley.com/journal/118556465/abstract> (last accessed 21 December 2009).
- Glacken, M. & Evans, D. S. (2006) *Measuring Height and Weight in School Children As a Public Health Indicator*. Department of Public Health, Health Service Executive West, Galway, Ireland. Available at: <http://hdl.handle.net/10147/44887> (last accessed 12 January 2010).
- Hanafin, S., Brooks, A.-M., Macken, A., Brady, G., McKeever, R., Judge, C., Ryan, B., Nic Gabhainn, S. & Gavin, A. (2008) *State of the Nations Children: Ireland 2008*. Department of Health and Children, Dublin. Available at: [http://www.omc.gov.ie/sonc2008/docs/SONC\\_08.pdf](http://www.omc.gov.ie/sonc2008/docs/SONC_08.pdf) (last accessed 22 December 2009).
- Haslam, D., Sattar, N. & Lean, M. (2006) Obesity- time to wake up. *BMJ*, **333**, 640–642. Available at: [http://www.eurobesitas.ch/articles/pdf/ABC\\_Obesity\\_time\\_to\\_wake\\_up.pdf](http://www.eurobesitas.ch/articles/pdf/ABC_Obesity_time_to_wake_up.pdf) (last accessed 22 December 2009).
- Haug, E., Rasmussen, M., Samdal, O., Ianotti, R., Kelly, C., Borraccino, A., Vereecken, C., Melkevik, O., Lazzeri, G., Giacchi, M., Ercan, O., Due, P., Ravens-Sieberer, U., Currie, C., Morgan, A. & Ahluwalia, N. & The HBSC Writing Group. (2009) Overweight in school-aged children and its relationship with demographic and lifestyle factors: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) Study. *International Journal of Public Health*, **54**, 167–179. Available at: <http://www.springerlink.com/content/423742513kj21638/fulltext.pdf> (last accessed 22 December 2009).
- Health Service Executive (2009) Performance Report January 2009. Health Service Executive, Naas, Kildare, Ireland. Available at: [http://www.hse.ie/eng/services/Publications/corporate/January\\_2009\\_Performance\\_Monitoring\\_Report\\_.pdf](http://www.hse.ie/eng/services/Publications/corporate/January_2009_Performance_Monitoring_Report_.pdf) (last accessed 21 December 2009).
- International Obesity Task Force (2005) EU Platform on Diet, Physical Activity and Health. International Obesity Task Force EU Platform Briefing Paper, Brussels, March 15. Available at: [http://ec.europa.eu/health/ph\\_determinants/life\\_style/nutrition/documents/iotf\\_en.pdf](http://ec.europa.eu/health/ph_determinants/life_style/nutrition/documents/iotf_en.pdf) (last accessed 7 December 2007).
- Kipping, R. R., Jago, R. & Lawlor, D. A. (2008) Obesity in children. Part 1: epidemiology, measurement, risk factors, and screening. *BMJ*, **337**, 922–927. Available at: [http://www.bmj.com/content/337/7675/Clinical\\_Review.full.pdf](http://www.bmj.com/content/337/7675/Clinical_Review.full.pdf) (last accessed 5 May 2010).
- Kramer, P. J., Bell, A. C., Sanigorski, A. M. & Swinburn, B. A. (2006) Overweight and obesity prevalence in children based on 6- or 12-month IOTF cut-points: does interval size matter? *International Journal of Obesity*, **30**, 603–605. Available at: <http://www.nature.com/ijo/journal/v30/n4/full/0803162a.html> (last accessed 21 December 2009).
- Lobstein, T., Bauru, L. & Unau, R. (2004) Obesity in children and young people: a crisis in public health. *Obesity Reviews*, **5**, 4–85. Available at: <http://www3.interscience.wiley.com/journal/118813302/abstract> (last accessed 21 December 2009).
- Malik, M. & Bakir, A. (2007) Prevalence of overweight and obesity among children in the United Arab Emirates. *Obesity Reviews*, **8**, 15–20. Available at: <http://www3.interscience.wiley.com/journal/117981318/abstract?CRETRY=1&SRETRY=0> (last accessed 23 May 2010).
- McMaster, C., Cullen, L. & Raymond, N. (2005) Overweight and obesity in Irish primary schools: retrospective cohort study. *Child: Care, Health and Development*, **31**, 499–506. Available at: <http://www3.interscience.wiley.com/journal/118698048/abstract?CRETRY=1&SRETRY=0> (last accessed 21st December 2009).
- National Taskforce on Obesity (2005) *Obesity, The Policy Challenges, The Report of the National Taskforce on Obesity 2005*. Department of Health and Children, Dublin, Ireland. Available at: [http://www.dohc.ie/publications/pdf/report\\_taskforce\\_on\\_obesity.pdf?direct=1](http://www.dohc.ie/publications/pdf/report_taskforce_on_obesity.pdf?direct=1) (last accessed 21 December 2009).
- Ogden, C. L., Carroll, M. D. & Flegal, K. M. (2008) High body mass index for age among US children and adolescents, 2003–2006. *JAMA*, **299**, 2401–2405. Available at: <http://jama.ama-assn.org/cgi/reprint/299/20/2401> (last accessed 5 May 2010).
- Ogden, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M. & Flegal, K. M. (2010) Prevalence of high body mass index in US children and adolescents, 2007–2008. *JAMA*, **303**, 242–249. Available at: <http://jama.ama-assn.org/cgi/reprint/303/3/242> (last accessed 5 May 2010).
- Stamatakis, E., Wardle, J. & Cole, T. J. (2010) Childhood obesity and overweight prevalence trends in England: evidence for growing socioeconomic disparities. *International Journal of Obesity*, **34**, 41–47. Available at: <http://www.nature.com/ijo/journal/v34/n1/pdf/ijo2009217a.pdf> (last accessed 22 April 2010).
- Sundblom, E., Petzold, M., Rasmussen, F., Callmer, E. & Lissner, L. (2008) Childhood overweight and obesity prevalences levelling off in Stockholm but socioeconomic differences persist. *International Journal of Obesity*, **32**, 1525–1530. Available at: <http://www.nature.com/ijo/journal/v32/n10/pdf/ijo2008104a.pdf> (last accessed 5 May 2010).
- Whelton, H., Harrington, J., Crowley, E., Kelleher, V., Cronin, M. & Perry, I. J. (2007a) *North South Survey of Children's Height, Weight and Body Mass Index, 2002*. Department of health and Children, Dublin. Available at: [http://www.dohc.ie/publications/pdf/north\\_southbmi.pdf?direct=1](http://www.dohc.ie/publications/pdf/north_southbmi.pdf?direct=1) (last accessed 21 December 2009).
- Whelton, H., Harrington, J., Crowley, E., Kelleher, V., Cronin, M. & Perry, I. J. (2007b) Prevalence of overweight and obesity on the island of Ireland: results from the North South Survey of Children's Height, Weight and Body Mass index, 2002. *BMC Public Health*, **7**, 187. Available at: <http://www.ncbi.nlm.nih.gov/pmc/>

articles/PMC1950090/pdf/1471-2458-7-187.pdf (last accessed 21 December 2009).

WHO (2010) *Childhood obesity surveillance in the WHO European Region, Fact Sheet 5, Geneva*. Available at: [http://test.cp.euro.who.int/document/Nut/Factsheet\\_5.pdf](http://test.cp.euro.who.int/document/Nut/Factsheet_5.pdf) (last accessed 11 October 2010).

Wisniewski, A. B. & Chernausek, S. D. (2009) Gender in childhood obesity: family environment, hormones, and genes. *Gender*

*Medicine*, 6, 76–85. Available at: [http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B7MDM-4VWKBB5-6&\\_user=10&\\_coverDate=12%2F31%2F2009&\\_rdoc=1&\\_fmt=high&\\_orig=search&\\_origin=search&\\_sort=d&\\_docanchor=&view=c&\\_acct=C000050221&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=20cac83299318e822556b45de193d2e3&searchtype=a](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B7MDM-4VWKBB5-6&_user=10&_coverDate=12%2F31%2F2009&_rdoc=1&_fmt=high&_orig=search&_origin=search&_sort=d&_docanchor=&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=20cac83299318e822556b45de193d2e3&searchtype=a) (last accessed 11 October 2010).