The Prevalence of Cardiovascular Risk Factors in Obese Children

Abstract:
E Carolan, A Hogan, J O'Connell, M Fallon, D Byrne, D O'Shea, D Cody
Department of Paediatric Endocrinology, Our Lady's Children's Hospital, Crumlin, Dublin 12

Abstract
Childhood Obesity poses a public health problem in Ireland. Complications associated include metabolic disease and cardiovascular disease risk. Our aim was to determine the prevalence of cardiovascular risk factors in a cohort of obese Irish children. Assessments were performed on obese children attending weight management clinic. Fasted blood samples were obtained prior to each participant to determine physical activity levels. Fifty-nine children (21 prepubertal and 38 pubertal/post-pubertal) were metabolically profiled. Mean±SD of z scores for BMI, Waist Circumference and Body Fat % were +3.29–0.48, +3.98–0.73 and +7.50–0.50 respectively. 43% (n=9) prepubertal and 68% (n=26) pubertal/postpubertal children had at least one other cardiovascular risk factor in addition to obesity. Increased moderate to vigorous physical activity is associated with reduced incidence of cardiovascular risk factors. There is a significant prevalence of cardiovascular risk factors among obese pre-pubertal children and pubertal/post-pubertal adolescents attending an Irish obesity clinic.

Methods
Ethical approval was granted by the Medical Research Ethics Committee, Our Lady's Children's Hospital, Dublin. The parents of all patients gave written informed consent prior to partaking in the study. A cohort of 59 children (21 pre-pubertal, 38 post-pubertal) aged between 6 and 18 years was recruited at their initial assessment in the weight management clinic. A further objective was to examine the relationship between measures of weekly physical activity levels and the occurrence of cardio-metabolic factors. There is a significant prevalence of cardiovascular risk factors among obese pre- and post-pubertal children attending our childhood obesity clinic. A further objective was to examine the relationship between measures of weekly physical activity levels and the occurrence of cardio-metabolic risk factors.

Aerobic exercise has been shown to reduce cardio-metabolic risk in obese children and adolescents. The presence of metabolic syndrome components predicts cardiovascular risk. Our objective was to determine the prevalence of these cardiovascular risk factors in obese pre- and post-pubertal children attending our childhood obesity clinic. A further objective was to examine the relationship between measures of weekly physical activity levels and the occurrence of cardio-metabolic risk factors.

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Polymer-Maltodextrin, Nutricia) was administered at 1.75gm/kg with a maximum of 75gm to each participant at 0 minutes. Repeat blood sampling for insulin, glucose via IV cannula was performed at 120 mins. Liver function tests and HbAlc were also determined on each participant. Fasting triglycerides and high density lipoprotein (HDL) cholesterol abnormalities were adjusted for age 14. Impaired glucose tolerance was defined as a glucose level greater than 7.0 mmol/L but less than 11.1 mmol/L at 2 hours post oral glucose load 15. Homeostasis model assessment for insulin resistance (HOMA-IR) was calculated using the following equation: fasting plasma insulin (U/L) x fasting glucose (mmol/L)/2.25. Scores ordinarily range from 0 to 35, higher scores indicate greater insulin resistance. The degree of insulin resistance was determined using cut-off points as published by Kurtoglu et al. Twelve participants in the prepubertal and pubertal stage (pre-pubertal: 2.22 in girls and 2.67 in boys/pubertal: 3.82 in girls and 5.22 in boys) 12. For participants in the postpubertal stage, the adult cut-off point of > 2.5 was used. Each subject was offered an Omron Walking Style 3 pedometer which they were requested to wear for 7 days. They were given a diary sheet to record activities and number of steps per day. This pedometer model has a 7 day recall. The returned addressed envelope was given to each subject to return pedometer and diary sheet. Each child was offered a Children's Physical Activity Questionnaire (CPAQ) and each adolescent a Youths Physical Activity Questionnaire (YPAQ). These are standardised physical activity questionnaires devised by Ekelund et al. that request subjects to record number of minutes spent in various activities ranging from sedentary to vigorous in nature. Reported number of minutes spent in moderate to vigorous physical activity (MVPA) were quantified. Statistical analysis was completed using Graph Pad Prism 6 Software. Data is expressed as mean-standard deviation. We determined differences between groups using student t-test and Mann Whitney U test where appropriate. Correlations were determined using linear regression models and expressed using Pearson or Spearman's rank correlation coefficient, as appropriate. P values were expressed with significance set at <0.05.

Results

Twenty-one children and thirty-eight adolescents participated in the study. Mean age of pre-pubertal children was 9.5–1.8 years (range 6.05-12.24 years) and of mid-pubertal/post-pubertal adolescents was 14.8–1.8 years (range 10.27-17.59 years). Body Mass Index, Body Fat Percentage (%) and Waist Circumference standard deviation score of pre-pubertal children was +3.4–0.9, +5.0 and +3.9–0.6 respectively. Body Mass Index, Body Fat Percentage (%) and Waist Circumference standard deviation score of mid-pubertal/post-pubertal children was +3.3–0.5, 3.2–0.9 and 4.0–0.8 respectively. All participants were obese with a BMI SDS greater than 2.0.

Twelve (20%) participants had systolic blood pressure readings in the hypertensive range (>95th centile for age, sex and height or BP SDS >1.64), 4 of these individuals were pre-pubertal. Six (10.2%) participants had pre-hypertensive systolic blood pressure readings (90th centile for age, sex and height), 3 of these individuals were pre-pubertal. Elevated blood pressure readings were confirmed with three repeat measurements. Four (7.5%) pre-pubertal children and 10 (26.3%) mid-pubertal/post-pubertal adolescents had high triglyceride levels and 7 (33.3%) pre-pubertal children and 18 (47.3%) post-pubertal adolescents had HDL levels lower than expected for age. None of the study participants had developed Type II Diabetes Mellitus but 5 (13.1%) adolescents had impaired glucose tolerance. There was a significant level of insulin resistance in both pre-pubertal children and mid-pubertal/post-pubertal adolescents, HOMA-IR was 4.5–0.3 and 4.7–2.8 respectively. Ten participants (15.9%) had biochemical evidence of non-alcoholic steatohepatitis (transaminitis), 3 (14.2%) were pre-pubertal. Abdominal ultrasound confirmed fat infiltration of the liver in 4 post-pubertal participants.

Correlation with physical activity

Thirty-three (55.9%) participants completed the physical activity questionnaire and 31 (52.5%) participants returned pedometers and 7-day diary sheet. There was a significant correlation between average pedometer steps per day measured HOMA IR (Pearsons Correlation = 0.35, P=0.04) (Figure 1) and HDL levels (Pearson’s Correlation 0.40, P=0.03). There was no significant correlation between other metabolic parameters and average pedometer steps per day. There was also a significant correlation between reported minutes of moderate to vigorous physical activity per week and HOMA-IR (Pearsons Correlation = 0.47, P=0.007), triglycerides (Pearsons Correlation = 0.48, P=0.007) and HDL (Pearsons Correlation 0.57, P=0.003).

Discussion

The increasing prevalence of cardiovascular risk factors among obese children and adolescents is widely reported. In the United States the prevalence rate of metabolic syndrome is 50% in severely obese children and adolescents 19. The incidence of Type II Diabetes Mellitus in high risk ethnic minorities such as African-American, Hispanic and Native American now comprises up to 50% of all newly diagnosed Diabetes cases in the United States. In European countries such as the Netherlands, up to 80% of obese children age reported to have at least one metabolic risk factor in addition to obesity. Our objective was to determine the prevalence of cardiovascular risk factors in a cohort of obese children and adolescents in Ireland. In our study we demonstrate that 35 of our 59 (58.3%) participants have at least one cardiovascular risk factor in addition to obesity. Twelve (20.3%) participants met the criteria for metabolic syndrome, 2 were pre-pubertal children. These pre-pubertal children were both female, aged 6.05 and 6.52 years respectively and had BMI SDS scores greater than 3.5. In addition, 54.2% of all children have evidence of insulin resistance as evidenced by HOMA-IR above their defined thresholds. In keeping with international reports our cohort of obese children have similar findings of metabolic abnormalities. This is very concerning for future risk of progression to Type II Diabetes Mellitus and premature cardiovascular disease. Obesity is not only associated with cardio-metabolic abnormalities but also with an increased risk of cancer 20. We have recently shown that key anti-tumour immune mechanisms are reduced in obese children compared to their non-obese counterparts (unpublished data). This cohort of Irish children are now showing evidence of adverse effects from obesity and that...
these effects are already beginning at an early age, prior to the onset of puberty.

The treatment of childhood obesity is difficult and optimal mode is controversial. There is increasing evidence that physical activity and aerobic exercise can ameliorate the adverse metabolic effects of childhood obesity. The CPAQ and pedometer data on physical activity levels, while not the most accurate or reliable means of assessment, does provide an accessible technique for participants in a hospital clinic setting. We demonstrate that physical activity, and particularly increased time in moderate to vigorous intensity activity, appears to have a positive impact on metabolic parameters including reduced triglycerides, reduced HOMA-IR and increased HDL levels. This supports previous studies showing that physical activity needs to be an integral part of the prevention and treatment of childhood obesity. There is a significant prevalence of cardiovascular risk factors among obese pre-pubertal children and pubertal/post-pubertal adolescents attending an Irish obesity clinic. These findings in the younger pre-pubertal child are particularly concerning. The provision of structured childhood obesity management plans are urgently needed to prevent future risk of premature cardiovascular disease.

Correspondence: D Cody
Department of Paediatric Endocrinology, Our Lady's Children's Hospital, Crumlin, Dublin 12
Email: Declan.Cody@olchc.ie

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References

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