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Making every contact count: recognising obesity in paediatric and young adult cardiology

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Abstract

Introduction: With increased survival, children with CHD are reaching adulthood, however, obesity amongst this cohort is an emerging problem. Making every contact count encourages clinicians to utilise contact to elicit behaviour change. The aim of this work was to identify whether the body habitus of children classified as obese was addressed during a clinical review. *Methods:* A retrospective observational cohort study was completed using a cardiology outpatient dataset from 2010 to 2019. Inclusion criteria are all children with a body mass index z score classified as obese (≥ 2 z scores). Individual electronic patient records were reviewed to identify long-term anthropometric measures including (i) recognition of body habitus, (ii) prescription of physical activity or dietary intervention, and (iii) referral to a weight management programme or dietitian. *Results:* From the cohort of 95 patients, 285 "obese clinical encounters" were identified, at the time of a cardiology clinic attendance. Of those, obesity was acknowledged in 25 clinic letters (8.65%), but only 8 used the correct terms "obese" or "obesity" (2.77%). Action to tackle obesity was recorded in 9.3% of cases with a direct referral to a dietitian being made on 3 occasions (1.04%). *Conclusions:* Body habitus is not being routinely addressed by cardiologists caring for paediatric and young adult cardiac patients. This study has recognised an alarmingly high incidence of missed opportunities to make every contact count, to manage those with obesity and associated risk factors.

CHD represents the highest rate of all major congenital abnormalities,[1] with a global prevalence of 9 out of every 1000 live births.[2] Global incidence is increasing, as a result of improved methods of detection.[3] Improved medical and surgical interventions,[4] occurring more commonly during infancy,[5] are leading to more children with CHD reaching adulthood.[6] Despite significant advances in survivorship, mortality risk remains high.[7] With the majority of adolescent and adult CHD patients displaying modifiable cardiovascular risk factors,[8] including metabolic syndrome,[9] early identification of excessive weight gain and contributing poor lifestyle behaviours is increasingly important.

Obesity is a public health epidemic, accounting for 4 million global deaths in 2015, with 70% being attributed to cardiovascular disease.[10] In the United Kingdom, childhood obesity is increasingly common with one in five children aged 10–11 classified as obese.[11] Obesity as a modifiable risk factor amongst children with CHD is emerging,[12] with evidence suggesting a shift from underweight to overweight occurring during mid to late childhood.[13] Poor growth during the first 2 years of life may increase the risk of unhealthy catch-up growth following corrective surgery, which combined with poor dietary behaviour[14] and physical activity,[15] increases the risk of being overweight or obese in children with CHD, equal to that of their non-CHD peers.[16–18] Obesity in CHD is also known to impact cardiac function in certain lesions[19–21] and is associated with increased risk of adverse surgical outcomes,[22] including length of ICU stay and duration of mechanical ventilation,[23] post-operative arrhythmias,[24] wound infection, and acute neurological and kidney injury.[25]

As part of making every contact count,[26] early identification of excess weight gain, poor diet, and physical inactivity should be a routine part of clinical practice, supported by performing anthropometry at every visit, accompanied by an explanation of the gap between the child's healthy weight and current weight[27] to the child and caregiver. This is especially important given that parents often have knowledge gaps in the understanding of their child's pathology[28] and limited ability to identify when their child is overweight.[29] Despite this, little time is devoted to cardiovascular risk assessment and management amongst both generalists and cardiologists caring for CHD patients[30] with obesity failing to be reported in excess of 85% of patients.[31]

The aim of this study is to review the identification of cardiovascular risk factors including (i) recognition of body habitus, (ii) prescription of physical activity or dietary intervention, and

Table 1. Primary cardiac pathology

CHD	n=	Non-CHD	n=
Aortic stenosis	5	Abnormal ECG	1
Anomalous left coronary artery from the pulmonary artery	1	Atrioventricular block	3
Aortic arch abnormality	1	Cardiac symptoms	9
Atrial septal defect	3	Cardiomyopathy	5
Atrio-ventricular septal defect	1	Channelopathy	1
Bicuspid aortic valve	4	Chromosomal disorders	3
Coarctation of the aorta	6	Electrolyte imbalance	1
Double inlet left ventricle	1	Electrophysiology	6
Double outlet right ventricle	1	Family history	7
Fontan	1	Hypermobility	1
Hyperplastic left heart syndrome	2	Hypertension	1
Patent foramen ovale	1	Mitochondrial disorder	1
Pulmonary artery stenosis	5	Heart murmur	2
Pulmonary atresia	1	Muscular dystrophy	2
Tetralogy of Fallot	4	Valve disease	2
Transposition of the great arteries	2		
Ventricular septal defect	11		

(iii) referral to a weight management programme or dietitian, in paediatric and young adult CHD and non-CHD patients attending cardiac outpatient clinic.

Materials and methods

In the single-centre, a longitudinal retrospective study was completed using a dataset collected from 2010 to 2019. Using the unique patient hospital numbers from this cohort, an electronic patient record data specialist extracted routinely imputed anthropometric measures recorded in the electronic growth chart. For those < 18 years of age, body mass index z scores were calculated using WHO AntroPlus software.[32] Obesity was classified as body mass index z scores ≥ 2 in <18 years and body mass index >30kg/m^2 in >18 years.[33] Weight was reported to the nearest 0.1kg and stature to the nearest 0.1cm.

The electronic patient record review was completed from 2010 until December, 2019. Clinical and demographic data collected from electronic records included age, gender, cardiac diagnosis, or reason for attending clinic, blood pressure, smoking status, clinic type (paediatric or adult), and anthropometric data (height, weight, and body mass index). Patients were categorised as either CHD or non-CHD based upon the clinical details available. Body habitus information was defined as anthropometry (e.g., height, weight, and body mass index) being recorded in the clinic letter or if it appeared anywhere in the text. An "obese clinical encounter" was defined as a consultation conducted by a cardiologist or specialist registrar, paired with an associated obese body mass index classification. Obesity was considered as acknowledged if a description to the effect was present, and this included but was not limited to the phrases "increased body mass index", "elevated body mass index", "excess weight", "elevated weight" or words or phrases to that effect. Other information collected from the clinical note included (i) discussion with child and caregiver regarding the physical status and (ii) recommendations for physical activity, referral to weight management programme or dietitian.

A data cleaning process was undertaken to exclude incorrect data entries, review extreme anthropometric measures, apply age criteria (10–18 years old), and excluding genetic syndromes known to affect normal growth, for example, trisomy 21. For the purpose of this study, a clinical encounter is defined as a clinical review conducted by a consultant cardiologist or specialist registrar, paired with an obese body mass index classification.

The retrospective audit was registered within University Hospital Southampton NHS Foundation Trust (reference 6434).

Results

Demographics

A cohort of paediatric patients recorded as obese, attending cardiac outpatient clinic (n = 188) between 2010 and 2019 were identified. Following the data cleaning process, 95 patients (male=54, 56.8%) remained and made up the cohort for this study. 52.6% (n = 50) had CHD with the most common pathology (22%) being ventricular septal defect (n = 11). Of the non-CHD patients 47.4% (n = 45), the most common reason for attending clinic is related to investigating cardiac type symptoms 20% (n = 9). At the time of obesity classification, all study patients were children (mean age: 14.1 ± 2.1 years) (Table 1).

Making every contact count

From the cohort of 95 patients, n = 518 complete anthropometric measurements were recorded, with a median value of 5 measurements (range 1–14) per patient. 58.9% were those with CHD. Of these 5.8% (n = 30) were normal weight, 31.1% (n = 161) were overweight, and 63.1% (n = 327) were obese. Of those patients with

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>1 body mass index z score documented 86.3% (n = 82), 40.2% (n = 33/82) were consistently obese across all recorded body mass index, 43.9% (n = 36/82) were continuously obese or overweight, and 15.9% (n = 13/82) had one or more normal body mass index classification(s). 25.3% (n = 24/95) patients had a single visit to the cardiology clinic with no further follow-up.

Recognition of body habitus

Following note review of the 95 patients, there were n = 285 "obese clinical encounters" of which 63.2% were CHD (n = 180), 36.8% non-CHD (n = 105), 84.2% (n = 240 paediatric cardiology), and 15.8%, (n = 45 young adult cardiology). A notion of "obese" or "obesity" in the corresponding clinic letter was present 2.8% (n = 8), with four of these occurring in a single patient across multiple visits. Excess weight was deemed to be acknowledged in a further 6% (n = 17) clinic letters without the specific terms "obese" or "obesity" being present. With these included, excess weight was considered as acknowledged in 8.8% (n = 25/285) of associated clinic letters of which 72% were CHD patients (n = 18/25). Most frequently used alternative phrase was "increased body mass index" 20% (n = 5). Despite being available for all obese clinical encounters, height and weight were reported in 48.1% (n = 137) clinic letters, with a higher rate reported in those with CHD 55% (n = 99/180) compared to non-CHD 36.2% (n = 38/105).

Dietary and physical activity intervention

Steps taken to address obesity were recognised in 9.4% (n = 27/285) clinic letters. A direct referral to specialist weight loss services (i.e., dietitian) was made 1.1% (n = 3/285) by the cardiologist, with an additional 1.1% (n = 3) request for the patient's general practitioner to arrange a referral. Most commonly, clinicians "encouraged weight loss" 4.6% (n = 13/285) with no specific recommendations, advice, or targets being recorded.

Making every contact count: follow-up

For those children, at the time of most recent clinic attendance, 36.2% (n = 31) patients had transitioned into the adult service of which 41.9% (n = 13) were CHD, 42.1% (n = 40) were paediatric (<18 years) of which 32.5% (n = 13) were CHD, and 25.3% (n = 24) had the single clinic visit with no follow-up.

Of those patients defined as being an adult at the initial time point, 2% (n = 1) remained obese at the time of most recent follow-up, 90.3% (n = 28/31) had systolic blood pressure reported of which 21.4% (n = 6) were hypertensive (>140mmHg), 57.1% (n = 16) were prehypertensive (120–140mmHg), and 21.4% (n = 6) were normal (<120mmHg). Across all adult patients at follow-up, systolic blood pressure and body mass index had a positive correlation (Fig 1) (n = 28, r = 0.61, p = 0.06). Smoking status was reported in 54.8% (n = 17) of which 88.2% (n = 15/17) were non-smokers, 5.8% (n = 1) was an ex-smoker, and 5.8% (n = 1) was a current smoker.

Over half (53.9%) of paediatric patients, at the time of most recent follow-up, remained obese. Systolic blood pressure was reported in 32.5% (n = 13) of which 23.1% (n = 3) were hypertensive (≥95th centile) (Tables 2 and 3).

Discussion

The primary and most significant finding of this investigation is the extremely low levels of acknowledgement and reporting of obesity by cardiologists caring for obese, paediatric, and young adult patients. Furthermore, where obesity was acknowledged, there was a reluctance to use the term "obese" with alternative, less clinical terms such as "increased body mass index" frequently used. In addition to low levels of acknowledging obesity, referrals to specialist weight loss services to address the issue were highly infrequent. The reasons behind these findings were not established, however, given that physicians are deemed as the most important source of information for young patients with CHD,[34] it is worrying that discussions about obesity are not routine practice. Under-reporting of childhood obesity is a seemingly common issue with similar findings being shown in children admitted to hospital for asthma,[35] attending emergency department,[36] in general practice,[37] and in general paediatric clinics.[38]

Abnormal growth patterns in children with CHD are common, particularly in those with tetralogy of Fallot, hypoplastic left heart or other single-ventricle physiology, and ventricular septal defects during the first 2 years of life.[39] High-risk growth in CHD has been defined as growth failure during the first 2 years of life, with subsequent rapid catch-up growth between the ages of 2–7 years and 8–15 years.[39] A retrospective study considering longitudinal growth in a cohort of children with CHD (n = 551) described various patterns of growth. Patients with single-ventricle physiology were shorter at 2 years of age, but had normal body weight compared to reference populations, while those with tetralogy of Fallot were more likely to be short and overweight at 2 years of age with ongoing excessive weight gain, resulting in a significantly higher Body mass index by the end of childhood. The consequence of these growth patterns is unknown, but it is speculated that adult adiposity in CHD is associated with an increased risk of metabolic and cardiovascular disease later in life.[31,40,41]

The results from our work mirror growth patterns is described by centres in the USA.[39,42] With increasing age, the incidence of overweight/obesity rose in line with the national average at 13.3% of children (n = 905). The prevalence of overweight/obesity amongst children with previous coarctation of aorta (n = 74) is 25.5% and in those with repaired atrial septal defects 21.5% (n = 64),[43,44] which is in line with rates reported elsewhere[31,45,46] and for those who became overweight/obese, the last recorded normal weight was between 6 and 10 years of age, which is comparable to children without CHD and linked to reduced levels of physical activity.[44] Children with CHD may be at higher risk of acquired cardiovascular disease compared to the general population, which may occur as a result of their underlying physiology and surgical sequelae; and as only a small proportion of individuals with CHD

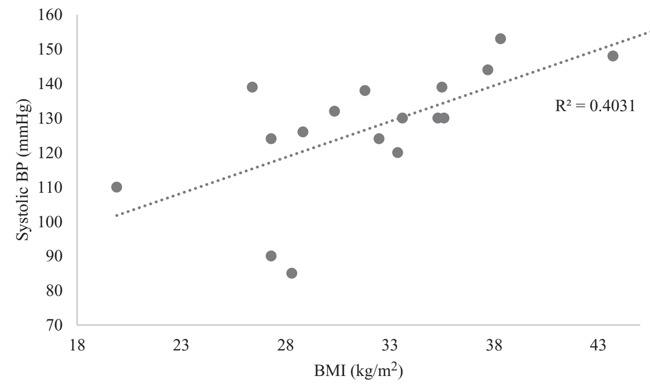

Figure 1. Adult CHD: Blood pressure and BMI.

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Table 2. Adult follow-up

	Total n = 31 (%)	CHD n = 13 (%)	Non-CHD n = 18 (%)
Gender			
Male	14 (45.16%)	5 (38.46%)	9 (50%)
Female	17 (54.84%)	8 (61.54%)	9 (50%)
Age years ±SD	20.21 ± 1.42	20.65 ± 1.27	19.89 ± 1.47
Weight status			
Normal	1 (3.23%)	0	1 (5.56%)
Overweight	7 (22.58%)	3 (23.08%)	4 (22.22%)
Obese	23 (74.19%)	10 (76.92%)	13 (72.22%)
Body mass index (kg/m^2) ±SD	33.67 ± 5.62	34.58 ± 5.18	33.12 ± 5.85
Systolic BP (mmHg)	128 ± 18	131 ± 18	126 ± 18
Smoking status			
Not recorded	14 (45.16%)	8 (61.54%)	6 (33.33%)
Non-smoker	15 (48.39%)	4 (30.77%)	11 (61.1%)
Smoker	1 (3.23%)	0	1 (5.55%)
Ex-smoker	1 (3.23%)	1 (7.69%)	0

±SD = standard deviation

Table 3. Paediatric follow-up

	Total n = 40 (%)	CHD n = 13 (%)	Non-CHD n = 27 (%)
Gender			
Male	28 (70%)	8 (61.54%)	20 (74.07%)
Female	12 (30%)	5 (38.46%)	7 (25.93%)
Age years ±SD	16.12 ± 1.40	16.21 ± 1.80	16.45 ± 1.23
Weight status			
Normal	5 (12.5%)	0	1 (5.56%)
Overweight	10 (25%)	3 (23.08%)	4 (22.22%)
Obese	25 (62.5%)	10 (76.92%)	13 (72.22%)
Body mass index score ±SD	2.07 ± 1.05	2.25 ± 0.67	2.10 ± 1.13

±SD = standard deviation

have optimal cardiovascular health, there is a need to advocate healthy lifestyle in adolescence and adulthood.[8]

Making every contact count[47,48] aims to promote health and well-being by identifying under- and over-nutrition.[49] Making every contact count in children with CHD could be made more effective by utilising the electronic patient record, with the use of automatic referral to dietitians of children who have breached predefined anthropometric body mass index z cut-offs, the benefit of which is the ability to use it in all age ranges for children, with improved efficiency and reproducibility in identifying children with nutrition risks,[50] and particularly those who are obese. Due to the study design, it was not possible to explore reasons why obesity was under-reported, however, one possible explanation between the disparities may relate to the relative simplicity of adult body mass index classification, compared to the need to use percentiles in paediatrics, due to the variability of body mass index with age. One possible solution to this would be to implement a body mass index z alert and referral for a dietetic review when a cut-off of >1 body mass index z score is exceeded, where height and weight measurements are entered into the patients electronic patient record.[49] An automated alert system could also be incorporated, by highlighting to the clinician that the patient they are seeing is classified as obese, and to prompt discussing this with the patient and family and introduce appropriate weight management strategies. Using an electronically embedded referral system reduces the error of incorrect classification of risk based on anthropometry, it is likely to be easy to complete, it is reproducible, and with the right criterion chosen as cut-offs will result in timely referral for weight management support.[51]

Blood pressure is not routinely being recorded in paediatric patients, with less than one-third of paediatric patients having blood pressure documents in clinic letter at the most recent follow-up. In adult clinics, blood pressure was routinely measured and documented (91.2%) with the majority of patients being classified as pre-hypertensive. This highlights an observed disparity in care between adult and paediatric cardiology clinics, likely due to available resources. Similarly, to body mass index, classification of hypertension in paediatric patients is less simple than in adults, with percentiles being required to classify blood pressure according to age and maturation. Again, this study did not explore reasons for blood pressure not being taken. Greater attention should be given to blood pressure in early life, particularly in those with elevated body mass index, as the correct management of this can lead to improved health.[52] This is especially important in CHD patients given their increased risk of cardiovascular morbidity and mortality.

The primary limitation of this study is its retrospective format. It should be emphasised that the correct data were limited, primarily due to the information contained in dictated clinic letters and notes, with some additional information obtained from electronic GP records where available. It is, therefore, unknown if discussions relating to weight management, physical activity, and other cardiovascular risk factors occurred during the consultation without it being documented. Regardless of whether or not the discussion occurred, a lack of communication or documentation of the issue highlights short comings in management of obesity.

Conclusion

In conclusion, our study highlights significant missed opportunities to first identify and second manage obesity in children and young adults attending cardiology services including those with CHD. Serious consideration is needed in how to identify obese individuals attending paediatric cardiology. Once identified, documented, and reported, basic guidance and encouragement on healthy eating and physical activity or exercise should be a routine practice. Alternatively, patients should be referred to specialist services such as dietitians or physical therapists where these specialist services are available.

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Statement of authorship. The authors made the following contribution to the manuscript: (1) LVM formulated the original idea and study design, (2) AS completed the data and statistical analyses and drafted the manuscript, and (3) TB, LVM, AS edited, read, and approved the final manuscript.

Conflicts of interest. None.

Ethical standards. This retrospective case note review was registered with the University Hospital Southampton NHS Foundation Trust as a clinical audit (audit number 6434).

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