5.0 DISCUSSION

The results from this evaluation are in line with what was hypothesized; significant improvements were seen in all the physiological and psychological outcome measures for participants attending the CIC programme, thereby indicating the continued acute effectiveness of this intervention in reducing health risk factors linked to overweight and obesity in children and adolescents.

5.1 General changes

Significant changes were measured pre-post intervention in all outcome variables for participants of the CIC programme in 2006-2008; mean body mass reduced by 5.56kg (6.0%), reduction in total percentage body fat was 4.0%, BMI decreased by 2.19 kgm⁻² (BMI SDS reductions = 0.27 units), waist circumference was reduced by 5.47cm (5.7%), improvements in blood pressure were seen with reductions of 3.23mmHg (2.7%) and 7.92mmHg (10.5%) in systolic and diastolic pressures respectively, and an increase in self-esteem of 0.22 units (9.4%) was achieved.

A younger cohort of participants attended the CIC intervention in 2008 (mean age = 13.2 ± 2.02 years) compared to the other cohorts in this group (2006, mean age = 14.1 ± 1.84 years; 2007, mean age = 14.3 ± 1.87 years). The differences in waist circumference and blood pressure identified between the cohorts in group 2 at baseline (pre-intervention) are likely to be attributable to this age difference, which is just natural variation of the sample.
5.1.1 Body mass

Mean weight loss achieved in group 2 was 5.56kg (6.0% reduction). This is not significantly different to the weight loss seen in group 1; 6.06kg body mass (6.8% reduction pre to post intervention). To facilitate safe weight loss whilst attending the CIC programme, an individual daily calorie allowance based on BMR was calculated for every participant to ensure adequate energy intake without excessive calorie deficit. Severe caloric restriction can lead to loss of lean muscle tissue and can interfere with growth and maturation (Rowland, 1990; Saris, 1993) and is therefore not appropriate. Other measures to ensure safe weight loss included discreet observation of participants to ensure adequate dietary consumption, and extensive education as part of the lifestyle programme in relation to balancing energy intake and expenditure in order to facilitate successful weight management with sufficient energy provision for normal growth and development.

In the adult population recommendations have been made for a 10% weight loss to reduce health risk factors (NIH, 1998). However there is currently no such guidance for safe weight loss to reduce health risk in the paediatric population. Although it is now acknowledged that the issue of overweight in children is a major concern, the focus often tends to be weight maintenance rather than weight loss due to the effect of linear growth, i.e. the child will ‘grow into’ their weight. This may be true in some cases where weight is slightly out of the healthy range, but for the very overweight or obese individual modest weight loss is often necessary to reduce health risk factors (Reilly, 2006). NICE recommends ‘realistic targets’ for weight loss; for adults the targets are usually a maximum weekly weight loss of 0.5–1.0kg with the longer term aim to lose 5–10% of original weight (NICE, 2006).
In the absence of any specific guidance for weight loss in overweight children and adolescents the degree of weight loss achieved on the CIC programme can be considered successful based on the recommendations available.

5.1.2 BMI

Significant reductions in BMI (2.19kgm$^{-2}$, 6.4%) were achieved in group 2. As this population are still growing it was expected that increases in stature would be seen; over the duration of these programmes a significant increase in height was observed (mean increase = 0.32 cm, 0.2%). BMI SDS was calculated for each individual to control for the influence of growth and significant reductions in BMI SDS (-0.27 units) were achieved. These reductions were not significantly different to those observed in the earlier evaluation of the CIC intervention; mean BMI SDS reduction group 1 = -0.29 units (Gately et al., 2005).

The widely recognised healthy BMI range for adults has been set as 20.0-25.0 kgm$^{-2}$ (WHO, 1997) but as discussed earlier in this report there are no definitive criteria for children and adolescents as BMI is not a static measurement in this population. NICE guidance recommends the use of BMI as a practical estimate of overweight in young people but advises that it is interpreted with caution as it is not a direct measure of adiposity. BMI in the paediatric population is interpreted on bespoke charts that utilise the 91st and 98th percentile cut-off points in BMI distribution to define overweight and obesity respectively (Cole et al., 1995). Despite the improvements seen over the course of the CIC programme, mean BMI scores post intervention for both groups (group 1 = 31.12 kgm$^{-2}$, group 2 = 31.91 kgm$^{-2}$) still exceed the 98th percentile for both boys and girls indicating that although effective at
significantly reducing BMI, the CIC programme is not a ‘quick fix’ solution to the problem of overweight and obesity and that changes implemented must be sustained in order to achieve long term weight management.

The CIC intervention aims to equip participants with the knowledge, understanding, skills and confidence to continue with their lifestyle changes in the longer term. Telephone follow-up is conducted with participants for 12 weeks after completion of the programme to review and monitor the individuals’ progress in maintaining the lifestyle changes implemented on camp back in their home environment. The major limitation of these reviews is that they rely solely on self-reporting in all aspects; weight, goal-setting, activity levels and dietary intake. Underreporting of food intake in overweight subjects has long been recognised as an issue (Baranowski & Domel, 1994; Stunkard & Waxman, 1981) and it is thought that over-reporting of physical activity may occur (Trost et al., 2001). The telephone follow-up aspect of the CIC programme is an area of current research and therefore it is not possible to comment on the effectiveness of this follow-up at present. Previous follow-up studies of weight management interventions (Epstein, Wing, Koeske & Valoski, 1987; Epstein et al., 1990; Gately, Cooke, Butterly, Mackreth and Carroll, 2000) have shown increases in body mass over time after the intervention period, but in the paediatric population this is to be expected as growth is likely to contribute to increased body mass. When growth was controlled for using percentage overweight, some studies have demonstrated maintenance and even further reduction of relative body mass following the intervention period (Epstein et al., 1990, Gately et al., 2000). However there is currently limited follow-up data available on the interventions to date which limits the inferences that can be made regarding long-term efficacy.
Mean actual reduction in percentage body fat from baseline (pre) to post intervention was 4.0% in group 2. This is significantly \((p = 0.016)\) different from the change observed in group 1; mean actual reduction = 2.6%. However, despite being calculated as a statistically significant difference, the magnitude of this difference is small, as determined by eta squared value of 0.017. Therefore the difference detected between groups 1 and 2 may not be of any practical significance; reductions in adiposity levels were achieved in both groups, and as it is excess adiposity that is associated with ill health and disease (Freedman et al., 1998; NIH, 1998; WHO, 2002) the reductions seen across all cohorts demonstrate a beneficial effect of the programme.

Acknowledgement of the method used to assess body composition must be made as this may have had some influence on the difference in scores observed. In the paediatric population, even reference methods for determining body composition are open to errors and this is further complicated in overweight and obese children as their tissue composition may be different to normal weight children (Goran, 1998). Body composition in group 2 was assessed using the Tanita Body Composition Analyser which utilises bio-electrical impedance analysis (BIA). Body composition in group 1 participants was assessed using BIA and the BODPOD air-displacement plethysmography system (Gately et al., 2005). It was intended to also obtain body composition data using air-displacement plethysmography for group 2 but unfortunately due to equipment malfunction insufficient data was obtained from the 2007 and 2008 cohorts for inclusion in the data analysis.
The difference between groups in percentage body fat assessed by BIA may be due to some extent to the level of accuracy of the Tanita Analyser and its operation by the researcher team. A study by Deurenberg (1996) identified that in the severely obese state several body-composition characteristics can be different which may affect bioelectrical impedance measurements; fat-free mass is often overestimated and therefore percentage body fat may be underestimated. To minimise observer error all researchers were rigorously trained in the use of the Tanita Analyser in accordance with the monitoring protocol.

5.1.4 Waist circumference

Group 2 achieved a significant (p<0.05) reduction in waist circumference pre to post intervention; mean reduction = 5.47cm (5.7%). This was not significantly different to the observations by Gately et al. (2005); in this study mean reduction in waist circumference = 6.29cm, (6.5%).

There can be difficulties in accurately measuring waist circumference in the overweight/obese subject; excess abdominal adipose tissue can make locating the waist problematic and performing this measurement can be a sensitive issue for some subjects as it is preferable to measure directly on the skin or over a thin layer of tight fitting clothing to improve the accuracy of the measurement. These difficulties were minimised by requesting all participants to wear swimwear under their regular clothes for ease of measurement and by ensuring all research team members were rigorously trained in this anthropometric measure. To reduce the error margin three measurements were performed and an average taken on each measuring occasion.
Excess abdominal adipose distribution has been linked to adverse impacts on health including CVD risk and type 2 diabetes (Lean, Han & Seidell, 1998; NIH, 1998). Guidance is available categorising increased health risk based on BMI and waist circumference in the adult population, as presented in table 6:

<table>
<thead>
<tr>
<th>BMI classification</th>
<th>Waist circumference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Overweight</td>
<td>No increased risk</td>
</tr>
<tr>
<td>Obesity I</td>
<td>Increased risk</td>
</tr>
</tbody>
</table>

Men: waist circumference <94 cm = low, 94–102 cm = high, and >102 cm = very high. Women: waist circumference <80 cm = low, 80–88 cm = high and >88 cm = very high.

Table 6: Assessment of the health risks associated with overweight and obesity in adults based on BMI and waist circumference. Taken from NICE, 2006.

However, currently there is such no guidance in relation to waist circumference for the paediatric population, despite this simple anthropometric measure being widely validated as a useful predictor of CVD risk factors in children (Freedman et al., 1999; Higgins et al., 2001; Maffeis, Pietrobelli, Grezzani, Provera & Tato, 2001; Savva et al., 2000). The current guidelines state that waist circumference is not recommended as a routine measure for defining overweight and obesity in children but may be used to give additional information on the risk of developing associated health problems when used in conjunction with more robust measures e.g. BMI (NICE, 2006). Despite the lack of reference data for health risk associated with waist circumference in young people, it should be noted that mean baseline waist circumference in group 2 (95.27cm) falls into the categories of increased risk of obesity-associated metabolic complications in adult males and females, and it is
therefore likely that waist circumferences of these sizes may also pose an increased risk to health in young people.

No significant difference was detected between the reductions in waist circumference of group 1 and group 2.

5.1.5 Blood pressure

Blood pressure was significantly reduced post intervention in group 2 participants. Systolic pressure dropped by 3.23mmHg (2.7%), and diastolic pressure was reduced by 7.9mmHg (10.5%). A significant between-group difference (p = 0.0015) was detected between the changes observed in diastolic pressure but not in systolic pressure; group 1 mean reduction in diastolic pressure = 4.97mmHg (7.0%). The magnitude of the difference between mean diastolic pressure reduction scores of the two groups however was small (eta squared = 0.016).

The most notable change in pressure in group 2 occurred in diastolic pressure, whilst the opposite trend occurred in group 1 with systolic pressure reductions being the greatest. A degree of inaccuracy in the measurements made may explain, at least in part, the differences seen between the groups. Automated blood pressure analysers were used in both groups but the reliability of these analysers can be variable; a study by Nelson, Kennedy, Regnerus and Schweinle (2008) identified inaccuracy in the use of automated blood pressure monitors when compared to the gold standard mercury column manometer, for subjects of all ages and blood pressure ranges. The limitations of the testing environment must also be considered; under ideal conditions the subject is at rest for five minutes prior to measuring blood pressure.
but in practice in the context of this study, this was not possible to achieve. The participants were excitable and anxious at pre and post intervention sessions and would not rest prior to measurement and therefore a 'white coat syndrome' influence may have been present. Also despite using a large cuff there was an ill-fit for some of the largest subjects which may have affected the accuracy of the readings obtained from these individuals.

5.1.6 Self-esteem

Significant improvements in self-esteem were recorded (mean increase = 0.22 units, 9.44%) demonstrating the efficacy of the fun-based, inclusive ethos of the intervention designed to increase skills and confidence and to provide positive experiences. A significant \( p = 0.003 \) difference with a small to moderate effect size (eta squared = 0.038) was revealed between the self-esteem scores of group 2 participants examined in the current study, and group 1 participants as evaluated by Gately et al. (2005).

Research indicates that adolescents who are overweight are at an increased risk of reduced self-esteem, poor body image and depression (Braet, Mervielde & Vandereycken, 1997; Sjoberg, Nilsson & Leppert, 2005) and that obesity can impact on many aspects of daily life; the 2003 Health Survey for England concluded that there is a significant adverse association between elevated BMI and health-related quality of life (HRQL) in both sexes in the general population (Soltoft, Hammer & Kragh, 2009). Low self-esteem has been linked with negative consequences such as behavioural disorders and other emotional concerns (Harter, 1993) and Harter and
Whitesell (2003) reported that adolescent self-esteem may remain stable into adulthood and therefore self-esteem in early life has potential long-term implications.

Other studies have also reported positive outcomes in relation to the impact of weight management interventions on self-esteem and other psychological issues in young people. A study by Huang, Norman, Zabinski, Calfas and Patrick (2007) evaluated a RCT of a one year primary-care based multi-component intervention (the PACE+ intervention). Significant improvements in self-esteem ($p = 0.006$) were identified in male adolescents according to weight change status and also over time independent of weight change, measured using the Rosenberg Self-Esteem Scale. Importantly, no adverse effects on self-esteem or body satisfaction were identified among any of the participants of this intervention regardless of weight loss, maintenance or gain. A recent study investigating the effects of a multidisciplinary lifestyle therapy intervention on quality of life in Brazilian obese adolescents (Lofrano-Prado et al., 2009) reported significant reductions in body mass, BMI and fat mass after short- and long-term therapy (12 and 24 weeks respectively), and significant ($p<0.05$) improvements in scores of depression, anxiety and quality of life after 24 weeks using a variety of validated assessment tools, including the Beck Depression Inventory (BDI), the Spielberger State-Trait Anxiety Inventory (STAI) and the ‘SF-36’ questionnaire to evaluate quality of life.

Self-esteem is a difficult concept to measure; it refers to “the extent to which one values oneself as a person” (Harter & Whitesell, 2003) and is therefore a subjective measure and there can be considerable inter- and intra-individual variation. A range
of different tools are available to assess self-esteem and other psychological variables and this makes direct comparison between assessments difficult.

In the current study a range of bespoke questionnaires developed from the Self-Perception Profile for Children (Harter, 1985) utilising the Likert scale were used to assess self-esteem. This tool has a high internal reliability \( (r = 0.73-0.86) \) and a good retest reliability \( (r = 0.8) \), and the questionnaires were specifically designed to be as user-friendly as possible for the paediatric population. However, limitations of the degree to which such assessment tools can accurately measure self-esteem that should be considered are the requirements of a certain degree of literacy, understanding and a reasonable command of the English language.

5.2 Group differences

Significant \((p<0.05)\) improvements were achieved in all outcome variables from baseline (pre) to post intervention for participants in group 2 (2006-2008 cohorts). Significant improvements across all outcome variables were also reported for the first four cohorts (group 1: 1999-2002) to go through the CIC programme (Gately et al., 2005). Comparison of these results identified that similar changes were attained in both studies. The changes seen pre to post intervention for groups 1 and 2 were only significantly different in three of the outcome variables measured; percentage body fat, diastolic blood pressure and self-esteem. Group 2 attained larger pre-post intervention changes for these variables (% body fat: group 1 = 2.6%, group 2 = 4.0%; diastolic blood pressure: group 1 = 4.97mmHg, group 2 = 7.92mmHg; self esteem: group 1 = 0.21 units, group 2 = 0.22) but the magnitude of the between-
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Group differences were only small to moderate (eta squared = 0.017; 0.024; 0.038, respectively) and therefore may not necessarily be of any practical significance.

Direct comparison between different interventions is difficult due to the limited data available and heterogeneity of the evidence that does exist (e.g. differences in programme design, outcome measures, samples etc.) but consideration of outcomes from other treatment programmes, acknowledging the limitations, can be useful to provide an indication of the relative efficacy of different interventions. An older study by Epstein, Wing, Koeske, Ossip and Beck (1982) reported a significant reduction in BMI of 1.37kgm\(^{-2}\) in a sample of obese children attending an eight week programme involving dietary restriction and programmed exercise, whilst the major residential weight-loss intervention currently operating in the USA, the Wellspring Camp programme, reported a mean reduction in body mass of 1.85kg per week and significant improvements in mood and fitness from the evaluative studies completed to date, which include an 18-month follow-up (Kirschenbaum et al., 2007). Outcomes from non-residential interventions have also been reported; mean BMI reduction of 1.9kgm\(^{-2}\) and waist circumference reduction of 4.3cm were achieved after the 12 week community based MEND programme (Sacher et al., 2005) and evaluation of the WATCH IT intervention (Rudolph et al., 2006) produced significant reductions in overweight at six months (-0.07 BMI SD). Nemet, Barkan, Epstein, Friedland, Kowen and Eliakim (2005) evaluated a 12 week multi-component non-residential programme in Tel Aviv, which utilised family participation, 30% dietary calorie deficit and twice weekly exercise sessions in its design and also included follow-up data as part of the study. Significant reductions were reported in body mass (2.8kg), BMI (1.7kgm\(^{-2}\)) and percentage body fat (3.3%) along with significant increases in
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habitual physical activity after this intervention, and at one-year follow-up significant decreases in BMI and body fat percentage persisted among the intervention participants demonstrating short and long term beneficial effects of this programme.

It may have been expected that significantly greater improvements in outcomes would have been achieved in participants attending the CIC intervention in 2006-2008 as these cohorts completed the programme several years after it was launched and initially evaluated, and with annual repetition it may have been expected that the intervention would have become more effective with the passage of time. The lack of differences between the two groups may be explained, at least in part, by the strong evaluative process undertaken during the development of the CIC programme.

Preceding work in the field of residential treatment options for paediatric overweight and obesity was carried out in the USA; Gately et al. (2000) carried out a longitudinal investigation of a residential weight-loss camp in Massachusetts, USA, with a 10 month follow-up. This eight week multi-component intervention produced significant \( p<0.05 \) reductions in body mass (7.4kg) and BMI (4.4kgm\(^{-2}\)) and one year after the initial measurements 89% of participants had a lower BMI than when they commenced the programme (mean BMI ± SD: week 0 = 32.90 ± 7.40kgm\(^{-2}\); week 52 = 30.05 ± 7.04kgm\(^{-2}\)). These results suggest a greater efficacy than the CIC programme but an important consideration is that this intervention imposed a standard caloric restriction; a 1400kcal/day energy allowance was used for all participants and differences in BMR were not considered. Provision of a hypo-caloric diet based on individual requirements is a superior method to ensure safe weight loss and alignment with the current guidance of a tailored, child-centred approach to weight management (NICE, 2006).
Rigorous evaluation of such programmes, supported by utilisation of the research evidence and best practice guidance in relation to paediatric overweight and obesity treatment, enabled the CIC programme to be designed with a primary aim of optimal effectiveness from the outset. Gately et al. (2005) reported “it may be that what demonstrates an effective weight management programme is that the outcomes are similar for different groups”.

5.3 Limitations

The results from this study can be used to give indications to inform practice but there are a number of limitations that should be considered when making inferences from this evaluation:

5.3.1 Programme

Limitations of the CIC programme include its limited capacity, the demanding staff/participant ratios and the fact that it is only possible to run the programme during extended school holiday periods. The intervention also appears expensive and therefore may only be accessible to more affluent families. However, increasing numbers of funded places are becoming available and cost considerations should include comparisons with the short- and long-term costs of obesity.

Also the design of the programme meant that it was not possible to identify a control group or to obtain random samples, and whilst multi-component interventions are recommended as the treatment of choice (NICE, 2006) the nature of such a design makes it impossible to detect the most effective aspects of the intervention.
5.3.2 Methodological weaknesses

The inherent weaknesses of some of the methods used in this study have been acknowledged; not all the outcome variables and/or their methods of measurement are robust. Data collected from the robust measures such as height and weight did not demonstrate any significant improvement or reduction in efficacy of the CIC programme between group 1 and group 2, whereas the less robust measurements, (body composition, blood pressure monitoring and self-esteem assessment) indicated significant between-group differences which may be attributable to some extent to the limitations of these techniques as discussed.

5.3.3 Lack of fitness data

Unfortunately no fitness data was obtained from the 2007 and 2008 cohorts due to equipment malfunction and therefore it was not possible to establish the impact of the programme on fitness levels in these participants. Previous evaluation of the CIC programme (Gately et al., 2005) identified significant improvements in aerobic fitness of participants (p<0.001; aerobic fitness pre = 2.04 ± 0.52 L/min, post = 2.28 ± 0.60 L/min).

The European Youth Heart Study (Ruiz, Rizzo, Hurtig-Wennlof, Ortega, Warnber & Sjostrom, 2006) demonstrated that both the amount and intensity of physical activity are positively associated with CVF in children. Current guidance stipulates that children and young people should undertake at least 60 minutes of moderate to vigorous physical activity each day, and children who are already overweight may need to do more than 60 minutes’ activity (NICE, 2006). Physical activity has positive effects on a range of co-morbidities independent of weight loss in the paediatric
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2009

population; a study by Brage et al. (2004) identified an inverse correlation between physical activity and clustering of metabolic risk factors (P = 0.008) in 8-10 year old children in Denmark. A review by Lotan, Merrick and Carmeli (2005) concluded that physical inactivity is ‘instrumental’ in the development of atherosclerotic CVD and other studies indicate that high CVF during childhood and adolescence is associated with a healthier CV profile in both youth and in later life (Brage et al., 2004; Ruiz et al., 2006; Twisk, Kemper & van Mechelen, 2002).

The CIC intervention incorporates six one-hour physical activity sessions daily, thereby far exceeding the current recommendations. All activities are fun-based and inclusive, are graduated to take into account a range of different fitness levels, and can be progressively intensified according to individual tolerance. Participants are encouraged to push themselves as their fitness and stamina improves over the course of the intervention as studies have indicated positive correlations between vigorous physical activity, body fat and CV fitness (Gutin, Yin, Humphries & Barbeau, 2005; Ruiz et al., 2006).

Epstein and Goldfield (1999) described the importance of physical activity in the treatment of childhood overweight and obesity and research is on-going to enhance the understanding of the value of physical activity in the wider paediatric population. The Bristol ‘3 P’s’ (parents, peers and physical activity) project is currently underway (Jago, Brockman, Calitri, Fox, Thompson & Page, 2009) which aims elucidate the factors that influence physical activity in 10-11 year-old children and identify ways to prevent the decline in activity that occurs during the transition from childhood to adolescence.
5.3.4 Family involvement

Current guidance recommends that interventions for children and adolescents should address lifestyle within the family and in social settings (NICE, 2006). Whilst the CIC provides a valuable social context for participants, the residential nature of the programme limits the opportunity for family involvement. Family engagement and education is very important if lifestyle change is to be achieved and sustained; research by Epstein (1996) identified the importance of family members as role-models and suggested that “the direct involvement of at least one parent/carer as an active participant in the weight loss process improves short- and long-term weight regulation.” A systematic review of RCTs of family involvement in paediatric weight management interventions (McLean, Griffin, Toney & Hardeman, 2003) also reported that parental involvement is positively associated with weight loss in children and recommended further research in this area in terms of which family members are involved and the level of their involvement to improve future interventions.

The family aspect of the CIC programme is currently being developed; the first and last days of the programme include workshops, games and discussion forums for family members and participants, but in view of the evidence available regarding the beneficial impact of family involvement in paediatric weight management this area requires substantial development to make it a more structured component of the intervention.
5.3.5 Observer error

*Intra-observer*: some degree of human error will have been incurred by the researchers collecting the data, but efforts were made to minimise these errors; researchers were rigorously trained to perform all outcome measurements according to the Leeds Metropolitan University monitoring protocol handbook, and where appropriate measurements were taken three times and an average calculated.

*Inter-observer*: efforts were made to ensure the same team of researchers performed all measurements for each cohort but there were occasions when this was not possible (sickness, days off etc.) Also, apart from the author, not all members of the research team participated in every CIC programme that made up each group; in particular different research teams were operating between groups 1 and 2 (1999-2002 and 2006-2008) and it is likely that this will have had some impact on the data collected.

5.3.6 Compliance

Compliance is an issue that requires consideration for all interventions. However, one of the major benefits of residential interventions is the ability to tightly control dietary intake and physical activity. Lean (2000) cited the inability of non-residential interventions to control the environment as a ‘major limitation’ and as a result the outcomes of these types of studies may be variable. The aims of CIC intervention are to encourage participants and provide opportunities to fully engage in the programme. The child-centred philosophy in conjunction with the residential setting promotes compliance; the programme is fun and sociable, physical activity is made enjoyable and there is very limited opportunity for variance from the dietary
programme. A wide range of physical activity sessions are incorporated to ensure there is something for everyone as studies have demonstrated positive relationships between perceptions of enjoyment and engagement in physical activity (De Bourdeaudhuij, Leverfre, Deforche, Wijndaele, Matton & Philippaerts, 2003; Strauss, Rodzilsky, Burack & Colin, 2001).

5.3.4 Cost

Currently the cost of participating in the CIC programme is high and this may mean that the intervention is biased towards more affluent families/young people. However obesity is a societal wide problem and indeed may be even more of an issue in the less affluent members of society as a large proportion of energy dense processed, convenience and ‘junk’ foods that are now widely available and popular with young people are often the cheaper options and the items frequently on special offer in supermarkets and food outlets (Maziak et al., 2007).

Work to reduce the cost of attending the CIC intervention is underway; partnerships are being established with local health authorities and PCTs, and funding secured for an increasing number of young people. Healthcare services are beginning to realise that investment early in at-risk individuals’ lives may prevent their progression to overweight/obese adulthood, which will not only benefit the individual but will also save a lifetimes ‘financial cost’ of obesity.
5.3.5 Statistical analysis

A drawback of the techniques used in the statistical analysis that should be acknowledged is the underlying assumption that the data are obtained using a random sample from the population. It was not possible for random samples to be used in this study due to the specific nature of the intervention.

Also it should be noted that although the author is not an experienced statistician, extensive research was carried out and external assistance sought where necessary in order to identify and accurately utilise the most appropriate statistical techniques; support in relation to the data analysis was provided by Professor Paul Gately, Leeds Metropolitan University.

5.6 Discussion summary

The results from this study demonstrate that this residential, multi-component intervention continues to have a positive impact on a range of health outcomes for overweight and obese young people and is aligned with current best practice guidance. The similarities in outcomes from this study and the previous evaluation of the CIC intervention (Gately et al., 2005) may be attributed to the concerted efforts to maximise efficacy during the programme development. An important consideration is that both studies have investigated the acute effectiveness of the CIC programme; follow-up research is currently underway to establish the longitudinal impact of this intervention.

The results from the current study are encouraging and can add to the evidence base of effective treatment options available for tackling overweight and obesity in the paediatric population.