PREVALENCE OF OBESITY IN MALTESE
CHILDREN AGED 5 AND 9 YEARS

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M.Sc. in Family Medicine 2010
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Author’s declaration

The undersigned, Dr. Christopher Scerri, hereby declares that the research presented in this dissertation is his own and has never been submitted to any degree in any other institution. This work was carried out under the supervision of Professor Charles Savona-Ventura M.D., D.Sc. Med., Accr.C.O.G., F.R.C.O.G., M.R.C.P.I.

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Supervisor’s declaration

In my opinion, this dissertation is good enough to be awarded at least a PASS by the M.Sc. Family Medicine Examining Board.

For my father and mother
Acknowledgements

I wish to thank the Department of Family Medicine of the University of Malta Medical School, particularly Dr Denis Soler MD MSc FRCGP and Dr. Philip Sciortino MD MSc MRCGP MMCFD who supported me throughout the preparation of this thesis. Continuous interest, criticism and guidance were given by my supervisor Prof Charles Savona-Ventura MD DScMed AccrCOG FRCOG MRCPI.

I would further like to acknowledge the help of all my colleagues who have in one way or another assisted me in performing this study. Particular mention must be made of Dr Victoria Farrugia Sant’Angelo MD MA MMCFD – Medical Co-ordinator Primary Child Health and National Immunisation Service, and Dr Neville Calleja MD MSc MSc DLSHTM – Director of the Department of Health Information and Research. Further acknowledgement must be made to Dr Trudy Wijnhoven – Technical Adviser for Obesity Surveillance at the WHO Regional Office for Europe Division of Health Programmes: Non-communicable Diseases and Environment for the kind permission granted for the use of the questionnaire. Useful assistance was received from the various heads of the schools which accepted to participate in the study and particular mention must be made of Mrs Dorothy Mifsud and Mrs Josephine Farrugia– School Nurses who helped with the examination of the students. Financial support to cover the study costs was made by Mr Hilary Paul Aguis BPharm MBA – General Manager of GlaxoSmithKline (Malta) Ltd.
The study would definitely not been possible without the collaboration of the children's parents who gave their time towards filling the circulated questionnaires. Finally, I would like to thank my parents, colleagues, and friends who have supported the various facets of my research endeavour. The study would not have been completed without their understanding and continuous support.
Summary

Reason for research: The steady increase in body weight noted in many developed countries over the last decades has also been noted in the Maltese population. As a result of childhood obesity, an increased burden at all levels of the healthcare system will occur. This study aims to assess by means of an epidemiological investigation of a representative random sample of Maltese schoolchildren aged 5 and 9 years:

- The current prevalence of obesity in Maltese children in a given sample and relate it to other developed countries.
- The risk factors which may be associated with the development of childhood obesity.

Methodology: This study was carried out on a random sample of a total of 431 children: 220 males (51.1%) and 211 females (48.9%) representative of the target population. Body Mass Index (BMI) and waist circumference were measured from the study population. On calculation of the BMI, the school children were divided into three groups: lean, overweight and obese using the International Obesity Task Force (IOTF) classification (Cole T.J. et al, 2000). A validated questionnaire was distributed to the children included in the sample population. The questionnaire was filled out by the parents and assessed child lifestyle characteristics including physical activity, nutrition, family general characteristics and birth weight. Both the anthropometric measurements and the variables assessed in the questionnaire were analysed to examine for any possible associations.
Results: The prevalence of childhood overweight/obesity in the five year old children was 28.8% for boys and 32.7% for girls while the prevalence rates for the 9 year olds was 48.9% for boys and 45.1% for girls. Inter-relationships were found between a history of metabolic disease in parents and obesity in the corresponding children. A statistically significant relationship was found between a history of a lack of breast feeding and obesity in the 5 year old children \( p=0.04 \). Statistically significant observations between birth weight \( p=0.002 \), anthropomorphic measures \( p=0.01 \) and physical activity \( p=0.002 \) were noted. Certain observations were also found between physical activity and corresponding obesity in both age groups, as were statistically significant relationships between diet and childhood obesity especially in the nine year olds. The overweight/obese nine year children consumed less fruit juice, milk whole fat and flavoured milk \( p=0.03, p=0.004, p=0.03 \) respectively as compared to their lean counterparts.

Discussion: The increase of prevalence of overweight and obese children especially in the nine year olds has reached alarming rates. The ‘U’ odds-risk pattern described in previous studies as the thrifty phenotype hypothesis of obesity was noted in this study. Here the nine year olds born in both the low \( [<2500g] \) and high birth weight \( [>4000g] \) groups showed to have higher anthropomorphic measures as compared to the children who were born of a normal birth weight \( [2500-3900g] \). Obese children could be spending more time performing passive activities instead of sleeping. It was also noted that the obese nine year olds were deliberately restricting the consumption of energy dense food in order to control weight.
Conclusion: The family physician is ideally placed to directly help reduce the impact of childhood obesity on the eventual health of the individual and indirectly reduce the demands placed on the health services. Childhood obesity has to be monitored more closely by the family physician especially with children exhibiting risk factors to becoming obese. These include children born of a low and high birth weights, lack of breast feeding, and a history of metabolic syndrome in the parents.
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Chapter 1

INTRODUCTION

Childhood obesity has become a global concern, particularly in the developed world. The steady increase in body weight noted in many developed countries, over the last decades has been noted also in the Maltese population. In Malta, obesity has reached alarming proportions with the highest reported prevalence levels approximating those of the United States. The 2001-02 Health Behaviour in Schoolchildren Study (HBSC) has shown that the overweight-obesity rate among American children was 31.9% [overweight 25.1%; obese 6.8%]; while the prevalence in Maltese children was 33.3% [overweight 25.4%; obese 7.9%] (Janssen et al. 2005).

A number of contributors may predispose to the development of obesity. However, although there are some genetic and hormonal causes such as Prader Willi syndrome and Cushing’s syndrome for the development of childhood obesity (Koletzko et al. 2002), most excess weight is caused by children eating too much and exercising too little. Children who eat more calories than are required for their development and growth will eventually become overweight. Many factors, usually working in combination, increase a child’s risk of becoming overweight. The amount and type of food imbibed is a major determining factor in the development of obesity. Regular consumption of high calorie foods, such as fast foods and vending machine snacks, contribute to weight gain (Thompson et al. 2004).
These foods are often high fat foods which are dense in calories. Soft drinks and sweets are also highly calorific and contributed towards excessive weight gain (Nicklas et al. 2001).

The high calorific intake is further supplemented by decreased and insufficient physical activity. There is an increasing tendency for children in the developed world to adopt inactive leisure activities, such as watching television or playing video games in preference to the more active activities enjoyed in earlier decades. This relative inactivity contributes to the development of obesity because the excessive imbibed calories are not used and burned up through physical activity. Sedentary children are more likely to gain weight (Carvalhal et al. 2007).

Some individuals may actually have a predisposition towards excessive weight gain. A number of receptor gene foci such as the B3-adrenergic receptor gene have been identified as predisposing towards the development of weight gain, insulin resistance and the earlier onset of Non Insulin Dependent Diabetes Mellitus (NIDDM) (Marti et al. 2004). The reported associations however remain tenuous; in spite of the expected situation where a child coming from a family of overweight people is assumed to be genetically predisposed to put on excess weight. This observation however may also be in part the result of an upbringing an environment where high calorie food is always available and physical activity is not encouraged. Epidemiological and animal studies, particularly among the Pima Indians, have suggested that the familiar predisposition towards increased weight gain
is also contributed to by intrauterine and neonatal nutrition (Ravelli et al. 1976), (Ravelli et al. 1999), (Pettit et al. 1983).

The social environment, because of food type availability and parental attitudes towards health living, can also contribute towards increased weight gain in children. Children from low income backgrounds are at a greater risk of becoming obese than those from the higher income groups. Poverty and obesity go hand in hand because low income parents lack the time and resources to make healthy eating and exercise a family priority. Psychological factors may also be contributory. Some children may overeat to cope with problems or deal with emotions, such as stress or boredom (Sobal and Stunkard 1989).

The present study will attempt to address the role of many of these health behaviour risk factors. The questionnaire that has been circulated to the parents of the children included in this study includes relevant questions that will enable the evaluation of any such associations.

Childhood obesity has been shown to confer long term effects on mortality and morbidity. Therefore the prevention of obesity in children and adolescence has been argued as being a public health priority to combat the adult obesity epidemic (Wang and Lobstein 2006). More than 60% of overweight children have at least one additional risk factor for cardiovascular disease such as raised blood pressure, hyperlipidaemia or
hyperinsulinaemia; and more than 20% have two or more risk factors (Dietz 2001). Type 2 diabetes, previously rare in children and adolescents, now accounts for over 30% of newly diagnosed cases in some parts of the United States. Most cases of Type 2 diabetes in children and adolescents are attributable to obesity (Fagot-Campagna et al. 2000). The probability of childhood obesity persisting into adulthood has been estimated to increase by 20% at 4 years of age and to 80% by adolescence (Guo and Chumlea 1999).

Besides the associated cardiovascular complications, an obese child can suffer from other conditions such as bronchial asthma and other respiratory problems, sleep disorders, liver disease, early puberty, eating disorders, skin infections and orthopaedic problems. The social and emotional fallout of obesity may also affect the overweight child. Children often tease or bully their overweight peer, who thus suffers a loss of self-esteem and an increased risk of depression as a result (Bruch 1941). Overweight children tend to have more anxiety and poorer social skills than normal weight children (Guo and Chumlea 1999). At one extreme, their problems may lead to acting out and disrupting the classroom; at the other, they may cause social withdrawal. Stress and anxiety may also interfere with learning, a situation that may give rise to a vicious cycle where a situation of increasing anxiety fuels a declining academic performance.

Social isolation and low self-esteem may create overwhelming feelings of helplessness in some overweight children. The loss of the hope of possible future life improvement may lead to depression. A depressed child may lose interest in normal
activities, sleep more than usual or cry a lot. Some depressed children hide their sadness and appear emotionally flat instead. Depression is as serious in children as it is in adults (Erermis et al. 2004). A vicious circle may also be created when a child is suffering from psychological problems as he or she may also resort to comfort eating.

The most significant long term consequence of childhood obesity is its persistence into adulthood with all the associated long term health risks. Calle et al. (1999) prospectively examined the risk of death related to Body Mass Index (BMI) in over a million adults and concluded that heavier men and woman in all age groups had an increased risk of premature death. Cardiovascular disease remains one of the principle causes for this excess mortality. Increased body mass index is also one of the important risk factors associated with the extent of atherosclerotic lesions in the aorta and coronary arteries in people between 2 and 39 years of age (Berenson et al. 1998).

The increasing prevalence of obesity has been accompanied by an increasing number of patients with the metabolic complications that fall under the heading of Metabolic Syndrome. The third National Cholesterol Program Adult Treatment Panel (ATP 111) (National Institutes of Health. 2001) defines the metabolic (or insulin resistance) syndrome as the presence in an individual of at least three of the following five risk factors: central or abdominal obesity, hypertriglyceridemia, hypertension, low HDL cholesterol, and high fasting glucose levels. The metabolic syndrome is a major risk factor for cardiovascular disease and type 2 diabetes. Although insulin resistance is also a key factor
for cardiovascular disease and type 2 diabetes, hyperinsulinemia is not included as a potential risk factor by the ATP 111, since its definition was designed for use in clinical practice with adults, and insulin levels are not usually assessed in clinical practice.

Components of the metabolic syndrome are present in children and adolescents as well as in adults (Jessup and Harrell 2005). Investigators from the Bogalusa Heart Study (Srinivasan et al. 2002) reported a prevalence of 3.6% in youth aged 8-17 years. However, other researchers have reported even much higher prevalence rates of metabolic syndrome in overweight or obese children. In a study of 490 subjects aged 4-20 years, 89% of whom had a BMI equal to or more than 97th percentile, the prevalence of the metabolic syndrome in the moderately obese subjects (defined as a BMI z-score of 2.0-2.5) was 38.7%; whereas almost half (49.7%) of the severely obese subjects (defined as a BMI z-score >2.5) had the features of the metabolic syndrome (Weiss et al. 2004).

The clinical consequences of the metabolic syndrome are mainly vascular, notably cardiovascular and cerebrovascular giving rise to coronary heart disease and stroke. Other metabolic consequences include type 2 diabetes and its’ complications, fatty liver, and hypercholesterolaemia. At the heart of metabolic syndrome is insulin resistance, which represents a generalised derangement in metabolic processes. Obesity is the predominant factor leading to insulin resistance. Other clinical problems associated with altered metabolism include the development of gallstones and certain forms of cancer. Postmenopausal obese women have a higher risk of developing breast and endometrial
cancer, risks that are augmented with an increased weight gain after the menopause (Grundy 2000).

Besides the metabolic-related complications, obesity contributes to other physical problems. The increasing strains placed on the supporting skeleton by the increased body mass predisposes towards osteoarthritis. Obesity has been associated with the development of osteoarthritis of the hand, hip, back and especially the knee. Deep vein thrombosis, gout, infertility, menstrual disturbances and surgical complications are also complications that have been directly linked to obesity. Severe obesity has further been associated with increased daytime sleepiness even in the absence of sleep apnoea or other breathing disorders (Dixon et al. 2007). This may contribute to a generalized fatigue and lack of concentration – factors that are possible causes of transportation accidents.

The impact that obesity has on the practice of family medicine is clearly evident and because of the increasing epidemic, the relevance of excessive weight on family medicine practice will continue to increase in the future. As adulthood obesity increases, the incidence of cardiovascular, cerebrovascular, musculoskeletal, psychological and pulmonary complications will become more frequent. As a result, this will exert an increasing burden at all levels of the healthcare system. An understanding of the dynamics of the problem of excessive weight gain in the Maltese setting will contribute towards the development of directed prevention initiatives.
1.1 Aims and Objectives

The main aim of this study is to estimate by means of an epidemiological investigation of a representative random sample, the current prevalence of obesity in Maltese school children aged 5 and 9 years.

The objectives of this study are:

- to compare the prevalence of childhood obesity in the Maltese population and that reported from other developed countries, and

- to assess the risk factors which may be associated with the development of childhood obesity in the Maltese setting.

1.2 Hypothesis

There has been an increase in childhood obesity over the last decades, and this is mainly due to an increase in the contributory factors, such as mainly lack of exercise and inappropriate diet. These factors are superimposed on the known increased risk of the metabolic syndrome in the Maltese population.
Chapter 2

LITERATURE REVIEW

2.1 Introduction

A number of population studies have suggested that the developed world is currently seeing an increase in childhood obesity which has reached alarming levels. The problems of excessive body weight in childhood are compounded by associated co-morbid metabolic disorders. The reason for this changing epidemiology are multifactorial, but has been related to altered nutritional and social habits, that contribute to weight gain during the early years of life through overnutrition and decreased calorific use.

2.2 Epidemiology

A 2004 review entitled ‘A Crisis in Public Health’ suggested that in the European region 22% of children aged 5 to 9 years and 16% of children aged 13 to 17 years were overweight. Of these 6% and 4% respectively were obese (Lobstein et al. 2004). The childhood obesity rate in various countries has apparently increased significantly over the
last decade. In the United Kingdom, a survey was conducted, studying obesity among children under 11 years, and predicted that childhood obesity prevalence among children aged 2 to 11 years as defined by local reference centiles will reach rates greater than 21% by 2010, having risen from 9.9% in 1995 to 13.7% in 2003 (Jotangia et al. 2005).

The International Obesity Task Force (IOTF) in 2006 conducted a systemic review to study the rate of change in prevalence of overweight and obesity among children in the European region (Jackson - Leach and Lobstein 2006). This review, involved a search of published and unpublished surveys, in an attempt to find pairs that could indicate rates of prevalence changes, within comparable population groups using comparable measures. The data from 45 pairs of surveys from 11 countries were analysed. Unfortunately, Malta was not included in this review as survey data was not available for estimate. The data confirmed that, with reported figures of 20.0 - 41.4% of boys and 22.5 - 38.8% of girls, a significant proportion of children are overweight or obese (Table 2.1). Using the 2006 United Nation child population (age 5-17.9 years), the review estimated that of the 71 million children in the European Union (EU25), an estimate of almost 22 million children were overweight or obese in 2006. This figure is believed to be rising by over one million children per year. About 23 percent of these, equivalent to an estimate of over 5 million children, are obese. This figure was also estimated to be rising by over 300 000 children per year. By 2010 the EU25 child population is projected to be nearly 73 million. Based on the conservative linear model and assuming that no changes in present trends occur; over 26 million children in this region will be overweight or obese; the figure rising by some 1.3
million children per year. Of the overweight children, 6.4 million will be obese; a figure that is estimated to rise by over 350,000 per year. Table 2.1 shows the estimated prevalence levels for childhood overweight and obesity for the European Union (EU25) as a whole for the year 2006.

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Table 2.1: Estimated prevalence of childhood obesity in EU25 – 2006 (Jackson - Leach and Lobstein 2006)

Malta does not fare better. Other studies on childhood obesity show that the prevalence in the Malta is rated as amongst the highest in the European Union. The IOTF in 2005 prepared a paper in conjunction with the European Association for the Study of Obesity (EASO) (Lobstein et al. 2004). This study stated that the Mediterranean islands of
Malta, Sicily and Crete, as well as the countries of Spain, Portugal and Italy, report overweight and obesity levels exceeding 30% among children aged 7 to 11 years of age. Malta in fact topped the list with an overweight rate of over 35%. Malta’s obesity rate in this age group was reported at being about 12%, third on the list following closely Portugal and Gibraltar. It should also be noted that Malta was not included in the list of EU countries reporting the percentage of schoolchildren aged 13 to 17 years who were obese or overweight, possibly due to the lack of available data for this age group.

In another study published in 2005 by Janssen et al, a comparison of overweight and obesity prevalence in school children from 34 countries and their relationship with physical activity and dietary patterns was performed. The data in this systemic review consisted of a cross-sectional survey of 137,593 youth aged 10 to 16 years from 34 (primarily European) participating countries of the 2001 to 2002 Health Behavior in School-Aged Children Study (HBSC). In this study, there were large variations in the prevalence of overweight (5.1-25.4%) and obese (0.4-7.9%) school-aged youth across the 34 countries. Here Malta topped the list again but now on a world-wide scale. The two countries with the highest prevalence of overweight (pre-obese and obese) and obese youth were Malta (25.4% and 7.9%) and the United States (25.1% and 6.8%).

In 1996, a point prevalence study was conducted on 3 year-old Maltese children. The prevalence of obesity in the three year-old children calculated as those greater than the 97th percentile, weight for height was 12.5%. While the prevalence of overweight children
considered as those between the 75th and the 97th percentile for weight for height was 26\% (Buttigieg 1997).

In another local study conducted in 2007, the height and weight for all school children entering the first year of primary school in Malta was performed. A total of 3,461 children were assessed with a mean age of 5.8 years. Based on IOTF criteria, over a quarter of Maltese school entry children were found to be overweight or obese. The rate of obesity-overweight for boys of this age group was noted to be 25.8\% while that for girls was 27.8\%. The rate of obesity for this age group was noted to be 10.4\% for boys and 9.8\% for girls (Grech and Farrugia Sant'Angelo 2009).

This study also showed inter-area differences with lower overall Body Mass Index (BMI) in the North West than in the South East area for both genders. This difference was only significant for boys (p=0.0008). Inter-regional differences were also apparent, with both genders consistently displaying lower BMIs in Central and Northern regions than in the Grand Harbour, which encompasses Valletta, Floriana and the ‘Three Cities’ on the opposite side of the Harbour (highest for both genders), and Southern regions.

Analysis by the school being attended showed that males had a clear stepped gradient from private to church to state schools. The regional differences were attributed to a lower level of education with regard to the consequences of obesity in the less affluent
Southern part of the island, and this is reinforced by the regional distribution, with the highest mean BMIs found in the least affluent Grand Harbour region. Table 2.2 shows the collected data of overweight and obese Maltese children of various years of age as reported in the literature.

<table>
<thead>
<tr>
<th>Year Date of data collection</th>
<th>Age range [years]</th>
<th>Boys % overweight/obese</th>
<th>Girls % overweight/obese</th>
<th>Cut-off criteria used</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>10</td>
<td>32.7</td>
<td>38.5</td>
<td>IOTF</td>
<td>(Lobstein et al. 2004)</td>
</tr>
<tr>
<td>1996</td>
<td>3</td>
<td>25.6</td>
<td>26.6</td>
<td>75th centile</td>
<td>(Buttigieg 1997)</td>
</tr>
<tr>
<td>2001-2</td>
<td>10-16</td>
<td>30.9</td>
<td>20.1</td>
<td>IOTF</td>
<td>(Janssen et al. 2005)</td>
</tr>
<tr>
<td>2007</td>
<td>4-5</td>
<td>27.8</td>
<td>25.8</td>
<td>IOTF</td>
<td>(Grech and Farrugia Sant'Angelo 2009)</td>
</tr>
</tbody>
</table>

Table 2.2 Reported childhood overweight/obesity rates from the Maltese studies

Excess weight in children is thought to be widely prevalent and on the increase. An analysis of the data for children collected in the Health Survey for England in 1998, showed that using international definitions of overweight and obesity, one child out of twenty-five is obese and one child out of five is overweight or obese. Between 1994 and 1998, the prevalence of overweight children increased from about 13 to 20%. The prevalence of excess bodyweight among children in England appears to be rising at an accelerating rate (Lobstein et al. 2003).
In Switzerland, overweight and obesity increased from 4% in 1960 to 18% in 2003 (Zimmermann et al. 2004); while in various regions of Spain, the prevalence of overweight in adolescence aged 13-14 years more than doubled from 1985 to 1995 (Moreno et al. 2000). In Iceland, the prevalence of overweight and obesity among 9 year-old children increased from 7.1% in boys and 12.2% in girls in 1968 to 22% in boys and 25.5% in girls in 1998 (Brien 1999). In Scotland between 1974 and 1994, the prevalence of overweight and obesity in children aged 4-11 years rose from 7.1% in boys and 10.7% in girls to 12.1% and 19% respectively (Cinn and Rona 2006). The steepest increase was seen from 1984 to 1994. The WHO (Europe) in 2005 published a fact sheet stating the obesity epidemic is spreading at particularly alarming rates in children. In France, the prevalence of childhood overweight and obesity increased from 3% in 1960 to 16% in 2000. In Poland, the prevalence increased from 8% to 18% between 1994 and 2000 (World Health Organisation. 2005).

In a study published by Wang and Lobstein in 2006, it was reported that based on secular trends, and assuming that they continue on a linear basis, it was estimated that over 46% of school-age children will be over-weight in the Americas by 2010; along with approximately 41% of children in the Eastern Mediterranean region, and 38% of children in the European region; 27% in the Western Pacific region, and 22% in South East Asia. By 2010, one in seven children in the Americas is predicted to be obese, as is about one in every ten children in the Eastern Mediterranean and European regions.
The IOTF in 2006 has observed that childhood overweight-obesity is increasing at an accelerating trend. The annual increase in prevalence of around 0.2% during the 1970s rose to 0.6% during the 1980s and to 0.8% in the early 1990s and in some cases reaching as high as 2.0% by the 2000s (Jackson - Leach and Lobstein 2006).

2.3 Risk Factors

Interactions between genetic, biological, psychological, socio-cultural, and environmental factors clearly are evident in childhood obesity.

2.3.1 Genetic and Biological Factors

In relatively few children, obesity develops as a secondary consequence of other disorders, such as hypothyroidism, human growth hormone deficiency, Cushing syndrome, and hypothalamic lesions caused by intracranial tumour, trauma or infection. Genetic defects which lead to syndromatic obesity, such as in patients with Prader Willi syndrome and Trisomy 21 are also found. Recently, other specific monogenetic disorders have been identified as rare causes of hyperphagia and obesity beginning in early childhood. Among these identified single gene defects are mutations in the leptin gene and the leptin receptor gene (Koletzko et al. 2002).
Syndromatic and monogenetic forms of obesity are not the only forms linked to genetic factors. In the general population, genetic factors play a role in the risk for development of obesity. In an investigation of 540 adults that had been adopted during childhood, no relationship between body weight centiles of adoptees and those of their adoptive parents was found. In contrast, the body weight centiles of the adoptees did closely correlate with those of their biologic parents, from whom they had been separated since early childhood (Stunkard et al. 1986).

2.3.2 Early Metabolic Imprinting

In addition to genetic predisposition, metabolic programming (Barker 1998) or metabolic imprinting (Waterland and Garza 1999) may also play a role in the risk of developing obesity. The environmental factors that affect the organism during specific, critical periods of early development modulate the windows exogenous factors during early life. These factors appear to modulate the risk of obesity later. One study focused on a cohort study of 19-year-old men who had been exposed, in the prenatal period or postnatal period to the Dutch famine of 1944-45. Maternal exposure to famine during the last trimester of pregnancy and the first months of life was related to lower obesity prevalence rates, but exposure during the first half of pregnancy was associated with higher obesity prevalence than in non-exposed controls (Ravelli et al. 1976). A later follow-up study of women and men aged 50 years, who were either exposed or not exposed to famine in late,
mid or early gestation, reported a higher BMI in exposed than in non-exposed women. However, there was no significant difference in men (Ravelli et al. 1999). Another study, reported a higher risk of later obesity for children of Pima Indian women with diabetes during pregnancy, than for children of mothers who did not suffer from gestational diabetes. This difference persisted after correction for other influencing factors (Pettit et al. 1983).

In a local study by Savona-Ventura and Chircop (2003), the birth weight distribution on Maltese women with gestational diabetes mellitus (GDM) showed a statistically significant U-shaped distribution with a greater prevalence of GDM being found in women of low (1000-2000 grams) and high (>4500 grams) birth weight. This relationship emphasizes the role that intrauterine nutrition has on pancreatic development. C. Savona-Ventura described how a maternal thrifty fugal restricted diet during pregnancy causes foetal neuro-endocrine changes with reduced pancreatic β-cell mass. This caused a ‘Thrifty Diet Phenotype’. In the persistence of a restricted diet in childhood and adult life, a lean individual exists and a normal glucose tolerance is maintained. If on the other hand there is an abundant availability of high fat and refined carbohydrate foods, an obese individual will develop an abnormal glucose tolerance, leading to impaired glucose tolerance and non-insulin dependent diabetes mellitus (NIDDM). This is due to the reduced pancreatic β-cell mass. Pregnant women with this phenotype develop GDM, causing foetal hyperinsulinism leading to macrosomia and at a later stage NIDDM. A vicious circle is set up as these children grow to motherhood and in turn become pregnant themselves. Maltese
women born during the severe siege conditions of World War II when presumably their mothers suffered food deprivation were shown to give birth to infants with a higher mean birth weight when compared to their counterparts born before and after World War II (Savona Ventura et al. 2007).

Postnatal feeding also appears to modulate the later risk of overweight and obesity. In a previously mentioned study (Buttigieg 1997), an association between the lack of breastfeeding and obesity in the corresponding three year olds was found ($r = 0.10; 0.1<p<0.2$). It was observed, that the children who had not been breastfed were found to be more obese and overweight than to those who had. In a cross-sectional survey of 9 357 German children entering school, BMI measurements were related to early feeding, diet, and lifestyle factors (Von Kries et al. 1999). The prevalence of obesity in children who had never been breastfed was 1.6-fold higher than in previously breastfed children. A clear dose-response effect of the duration of breastfeeding on the prevalence of later obesity emerged from this study. The protective effect of breastfeeding was not attributable to differences in social class or lifestyle. After adjustment for potential confounding factors, the study found that breastfeeding remained a protective factor against the development of overweight and obesity. Thus, in industrialized countries, promoting prolonged breastfeeding may help decrease the prevalence of obesity in childhood. The potential underlying mechanisms of this phenomenon remain to be elucidated.
Together, these findings indicate that, in addition to genetic disposition, environmental factors, including intrauterine and postnatal nutrition, strongly influence the risk of eventual obesity development.

2.3.3 Current Lifestyle and Energy Balance

Obesity is the consequence of an overall positive energy balance maintained over time, that is, the metabolic energy intake exceeds the energy expenditure for basal metabolic requirements, thermoregulation, and thermogenic effects of feeding, physical activity and growth (Rosenbaum et al. 1997). Several studies related basal energy expenditure to the metabolically active lean body mass and found no basal energy expenditure difference between obese children and children of normal weight (Southern et al. 1999) (Schutz et al. 1999). Thus, the major determinants of obesity development are energy expenditure induced by physical activity and energy intake from foods.
2.3.4 Physical Activity

The degree of a person’s physical activity markedly affects total energy expenditure and thus energy balance. Low physical activity levels are associated with obesity in children and adolescents, and may be both the cause and consequence of increased weight (Klesges et al. 1995). Although young people are more physically active than adults, the worldwide increase in overweight among youth has raised concerns about the adequacy of habitual activity in children and adolescents. Societal changes such as increased car ownership, unfriendly walking and cycling environments, and increasing choices in electronic entertainment, combined with the concern about increased weight, have created a need to understand physical activity trends in youth. In some studies, the obesity risk of a child has been correlated to time spent viewing television, that is, times with low level of physical activity and low energy expenditure.

One such study examined the relation of overweight and obesity to activities in Portuguese children aged 7 to 9 years (Carvalhal et al. 2007). The purpose of this study was to explore the association among the following variables: physical activity, television viewing time, videogames and obesity. Eating while watching TV is a common practice among Portuguese families; computer use requires a more centred focus of attention and the use of both hands. Eating snacks, while playing on the computer takes place during small breaks between the different games or change of level of difficulty. To support this
no association was found regarding the time children use the computer with the BMI or obesity. The average mean values for BMI were higher for both boys and girls that did not practice physical education while most boys and girls spent between 4 to 6 hours watching TV. The mean values for BMI rose as the hours that both boys and girls spent watching TV; playing electronic games and computer use. The prevalence of obesity rose as the hours of watching TV increased. The highest prevalence recorded was 32.5% for both genders that watched TV for 4 to 6 hours per day.

An obesity review based on the WHO's 2001-2002 HBSC study (Janssen I. et al. 2005) further found that within most countries, physical activity levels were lower and television viewing times were higher in overweight compared to normal weight youth. In addition, the Third National Health and Nutrition Examination Survey (NHANES III) 1988-1994, where the collected data of 4,096 US children aged 8 to 16 years was examined, it was found that the prevalence of obesity was lowest among children watching 1 or fewer hours of television a day, and highest among those watching 4 or more hours of television a day (Crespo et al. 2001).

In a study performed by Klesges et al, the effects of television viewing on resting energy expenditure (metabolic rate) in children were assessed. This study sought to identify a metabolic mechanism that may explain the relationship between television viewing and obesity, and to determine whether television viewing affected obese and normal-weight children differentially. Television viewing was found to acutely decrease resting energy
expenditures in both normal-weight and obese children. There were no statistically significant differences in metabolic lowering between the two groups; however, the obese children experienced an average decrease of 265 kcal compared with 167 kcal for normal weight children. It was also noted that in general, obese children watch more television per day than normal weight children and would likely have lower metabolic rates over time compared with normal weight children. The physical activity level of children was also found to be related to socioeconomic status and living conditions, peer pressure, and the degree of physical activity of the parents (Klesges et al. 1993).

2.3.5 Diet and Obesity Risk

Dietary habits and food preferences, caloric content of the diet, and nutrient composition all appear to modulate the risk of obesity development. Dietary habits of children and adolescents are influenced by parents and other household members, peers, advertisements and media, the social context of eating, and possibly early feeding experience in infancy and genetic variation in taste preferences (Birch and Fisher 1998).

People's eating habits have changed significantly in recent decades. Globally the amount of food available has risen over time. On average, a woman needs to consume
2 000 calories a day to maintain her weight, and the figure for men is 2 500 calories. In 1961, the number of calories available per person per day was 2 300. This has risen to 2 800 by 1988 and is likely to exceed 3 000 by around 2015. Also, food prices have fallen over time – the real price of rice, wheat, maize, fat and sugar fell by about 60% between 1960 and 2000. At the beginning of the 20th century, people ate less than 5kg of sugar per year. In Europe today, this has risen to between 40 and 60 kg. At the same time, people are not eating enough fruit and vegetables (World Health Organisation. 2006).

The National Statistics Office of Malta (NSO), in 2008, has estimated that the consumption expenditure on food incurred by private households has risen from €491 million in 2003 to €560.8 million in 2007. In an article written by Bellizzi in 1993, the changing eating habits of the Maltese were studied. In this study the trends of the Maltese eating habits were traced from 1961 to 1988. The supply of cereals, which includes wheat products such as bread and pasta, rice, maize and oats, and dry pulses fell steadily from 1961 but appeared to be stabilizing and even rose slightly from 1986-88. Fruits and vegetables had increased steadily in supply: in 1986-88 being over 60% higher than that in 1961-63. Potato supply was more erratic with the trend exhibiting peaks and troughs. However, there was an overall fall of 43% in supply over nearly thirty years. There was a 20% increase in supply of sugar over the time period under consideration. The supplies of meat, fish, eggs, milk and dairy products had increased steadily since 1961. In 1986-88 meat supply was nearly twice that in 1961-63. The supply of milk and dairy products showed an increase of 67% in thirty years, while that of eggs nearly doubled. The supply of fish had been increasing steadily since 1961 to 1988, but still was low when compared with
that of meat. The supply of total separated fats, which include vegetable oils and their margarines, butter and lard increased by 66% in thirty years.

Over the past decades, the Maltese diet has changed from one that is high in complex carbohydrates and low in fats, to one that is high in total fats, and low in complex carbohydrates. These changes are due to a reduction in the consumption of cereals and an increase in consumption of meat, milk, dairy, eggs and vegetables oils.

Worldwide restaurant food consumption increased considerably in children and adults between 1977 and 1996. The proportion of foods that children consumed from restaurants and fast food outlets increased by nearly 300% during that 19 year period (Johnson - Taylor and Everhart 2006). Portion sizes in restaurants increased from 1970 to 1999 with the result that soft drinks contain an additional 206 kJ, hamburger 407 kJ, and French fries 286 kJ (Young and Nestle 2002).

In a longitudinal study of 101 girls aged 8-12 years, the frequency of eating quick-service food at base line was associated with changes in BMI z scores at 11- and 19-year follow-up (Thompson et al. 2004). Data from another study suggested that older children who consume fried foods away from home more frequently over a 1-year period were heavier and had greater total energy intake, compared with children with low frequency of fried food consumption away from home (Taveras et al. 2005).
In the Life Style Survey 2007, it was reported that restaurants were found to be the most frequented places by the adult population, with 79% reporting that they frequented restaurants in the 12 months predating the survey (National Statistics Office. 2009).

Sweetened beverage consumption and its possible association with the increased prevalence of overweight and obesity among children have been assessed in various studies. The Bogalusa Heart study examined energy intake among 10-year-old children from 1973 to 1994 and findings from the study showed that children who did not consume sweetened beverages did not have increased energy intake. However, energy intake did increase among children who consumed sweetened beverages (Nicklas et al. 2001). A pilot intervention study, (Ebbeling et al. 2006) showed that reducing sweetened beverage consumption, reduced body weight in adolescents in the upper baseline BMI tertile. Interestingly, when considering intake of soft drinks in 34 (primarily European) countries, no association with overweight status was found in 91% of the countries examined. In addition, the frequency of sweets intake was lower in the overweight than in the normal weight youth (Janssen. et al. 2005).

Other dietary risk factors for overweight and obesity include family and parental dynamics. Food insecurity may contribute to the inverse relationship of obesity prevalence with socioeconomic status, but the relationship is a complex one (Alaimo et al. 2001). Other barriers, low income families may face are lack of safe places for physical activity and lack of consistent access to healthy food choices, particularly fruits and vegetables.
Low cognitive stimulation in the home, low socioeconomic status, and maternal obesity all predict development of obesity (Strauss and Knight 1999). There is accumulating evidence for the detrimental effects of over-controlling parental behaviour on children’s ability to self-regulate energy intake. For example maternal restraint, verbal prompting to eat at mealtime, attentiveness to non-eating behaviour, and close parental monitoring all may promote undesired consequences for children’s eating behaviour (Klesges et al. 1991). Children and adolescents of lower socioeconomic status have been reported to be less likely to eat fruits and vegetables, and to have a higher intake of total and saturated fat (Krebs-Smith et al. 1996).

2.4 Obesity Co-morbidities

Attention to childhood overweight and obesity is highly warranted, as overweight and obese children are likely to be obese into adulthood and to have non-communicable diseases at a younger age. Obese children also have a direct increased risk of disease, and they often suffer from stigmatization. Given the rapid increase in the prevalence of childhood obesity, the health consequences are likely to be underestimated. For most non-communicable conditions resulting from obesity, the risks depend partly on the age of onset and duration of obesity. Obese children suffer from both short-term and long-term health consequences.
More than 75% of all deaths in the European Region are caused by non-communicable diseases, the highest proportion in the world. Coronary heart disease is the most common cause of premature death, alone accounting for 16% and 12% of all premature deaths in men and women, respectively. The risk of disease in all populations increases progressively from a BMI of 20–22. According to The World Health Report 2002, a BMI above 21 kg/m$^2$ accounts for 10–13% of deaths in the European Region, a rate that is in general higher than that in other parts of the world (Branca et al. 2007).

The Health Behaviour in School-aged Children study conducted in 2001–02, which gathered self-reported data on the weight and height of more than 100 000 children in 35 countries in Europe and North America, indicated that 11.7% of 13-year-olds and 11.4% of 15-year-olds were overweight. About one quarter of overweight children are obese and are likely to develop type 2 diabetes mellitus, heart disease and other chronic diseases before or during early adulthood (Currie et al. 2004).

In a report carried out by IOTF in 2006, Lobstein and Jackson - Leach have stated that in the most conservative estimate, over 27 000 obese children in the EU have type 2 diabetes, while over 400 000 have impaired glucose tolerance. Over a million obese children are likely to show a range of indicators for cardiovascular disease, with an estimated 1.1 million suffering hypertension and a similar number showing raised total blood cholesterol. Approximately 1.2 million obese children are likely to be affected by the
metabolic syndrome. Fatty liver (hepatic steatosis) is likely to be found in 1.4 million children.

Several reviews summarize consequences, both short-term and long-term, of childhood obesity. These can be divided into two main groups i.e. the physical health consequences and the psychosocial consequences.

2.4.1 Physical Health Consequences

2.4.1.1 Endocrine

The rise in the prevalence and severity of childhood obesity has been accompanied by the appearance of a new paediatric disease: type 2 diabetes mellitus. Rosenbloom et al. in 1999, has stated that one-third of the newly-diagnosed diabetics aged between 10-19 years were type 2 diabetics. The prevalence of type 2 diabetes in children and adolescents is increasing in both developed and developing countries (Kaufman 2003).

The initial report of a high frequency of type 2 diabetes in young patients came from the carefully studied Pima Indian population, in which 1% of those 15–24 years of age had diabetes that was associated with obesity and long-term diabetic complications.
Five of the individuals had been treated with insulin, and four had experienced ketoacidosis (Savage et al. 1979).

Type 2 diabetes in children is a relatively recent condition and data on long-term outcomes are sparse. The risk of myocardial infarction (MI) was 14-fold higher in young adults (diagnosed aged 18–44 years) with type 2 diabetes, compared to age-matched control subjects. This, is in contrast to adults with later onset type 2 diabetes (diagnosed age >45 years) whose risk of developing MI was approximately four times higher than controls (Hiller and Pedula 2003). A survey of 51 patients (aged 18–33 years) who developed type 2 diabetes as children, showed that at the time of the study, 9% had died, 6% were on dialysis, one had undergone toe amputation and one was blind (Dean and Flett 2002).

Recent studies have shown that the rates of microalbuminuria, hypertension and dyslipidaemia are significantly higher in adolescents with type 2 diabetes, when compared to adolescents with type 1 diabetes of similar age (Eppens et al. 2006) (Maahs et al. 2007). Acute complications, although rare in children with type 2 diabetes, can be life-threatening. It was reported, that seven young people with unrecognised type 2 diabetes had died of hyperglycaemic hyperosmolar non-ketotic syndrome (HHNK) (Morales and Rosenbloom 2004). In a recent case series, 3.7% of children diagnosed with type 2 diabetes had at least one episode of HHNK. The case fatality rate in this series was 14.3% (Fourtner et al. 2005). The evidence to date, therefore, is that although childhood onset type 2 diabetes mellitus is still relatively rare when compared to adult onset type 2 diabetes, the impact on affected individuals may be more severe.
In a local study (Schranz 1999) has stated that between 1996 and 2020, the prevalence of type 2 diabetes in the Maltese islands, for people older than 14 years of age, is estimated to rise from 5.7% to 7.1% in male subjects and from 9.7% to 11.8% in female subjects. This expected increase in overall prevalence of diabetes (23%) in Malta, is close to the projected rise in prevalence of 27% predicted for people >20 years living in developed countries during the first quarter of the 21st century (King et al. 1998).

The third National Cholesterol Education Program Adult Treatment Panel (ATP III) defines the metabolic (or insulin resistance) syndrome, as the presence in an individual of at least three of the following five risk factors: central or abdominal obesity, hypertriglyceridemia, hypertension, low HDL cholesterol, and high fasting glucose levels (National Institutes of Health. 2001). The metabolic syndrome is a major risk factor for cardiovascular disease (CVD) and type 2 diabetes. Although insulin resistance is also a key risk factor for CVD and type 2 diabetes mellitus; hyperinsulinemia is not included as a potential risk factor by the ATP III. The definition was designed for use in clinical practice with adults, and insulin levels are not usually assessed in clinical practice. Components of the metabolic syndrome are present in children and adolescents, as well as in adults (Jessup and Harrell 2005).

A study on children and adolescents between 12-19 years of age, in the third National Health and Nutrition Examination Survey (NHANES III) data set, estimated a prevalence of metabolic syndrome of 4.2% (Cook et al. 2003). Investigators from the
Bogalusa Heart Study, reported a prevalence of 3.6% in youth 8-17 years of age (Srinivasan et al. 2002). However, researchers described much higher prevalence rates in children who are overweight or obese. In a study of 490 subjects aged 4-20 years, 89% of whom had a BMI 97th percentile, the prevalence of the metabolic syndrome in moderately obese subjects (defined as a BMI z-score of 2.0-2.5) was 38.7%, whereas almost half (49.7%) of severely obese subjects (defined as a BMI z-score > 2.5) had the syndrome (Weiss et al. 2004). In another study among children and adolescents 8-19 years of age, the prevalence was 6.8% in those who were at risk for overweight (85-95th percentile of BMI) and 28.7% in those who were overweight (BMI 95th percentile) (Cruz et al. 2004).

A history of being born small for gestational age, has also been shown to be a risk factor, for the development of insulin resistance and the metabolic syndrome in adulthood (Levy - Marchal and Jaquet 2004). Insulin resistance seems to be the key element driving the development of the pathophysiological processes, leading to the development of altered glucose metabolism, dyslipidemia, and hypertension. Newborns, who are born small for gestational age, suffered from a period of limited nutritional resources and/or of the effect of other stressogens during the intrauterine period. The period of exposure to limited energy resources, is followed by a postnatal period of "catch-up growth", resulting from a practically limitless supply of calories. These intrauterine and postnatal growth patterns, possibly cause a programming of specific genes in multiple tissues, that promotes efficient energy storage, which in the context of energy surplus, may lead to early development of insulin resistance (Weiss and Kaufman 2008). In the Pima Indian population, it has been
shown that offspring born after their mother developed diabetes were more obese as children and more likely to have diabetes in their 20s than their siblings who were born before their mothers developed diabetes (Franks et al. 2006). The absence of similar phenomenon in offspring of diabetic fathers, suggests a “programming effect” characteristic of the diabetic intrauterine milieu. In a previously mentioned local study by Savona–Ventura and Chircop (2003), the data suggests that the intrauterine millieu interieur, whether one of nutritional deprivation or one of nutritional plenty, results in changes in pancreatic development and peripheral response to insulin, that may lead to adult-onset gestational diabetes mellitus and type 2 diabetes.

The obesity-related morbidities that emerge early in childhood are an alteration in glucose metabolism and fatty infiltration of the liver (non-alcoholic fatty liver disease - NAFLD). Although an accelerated atherogenic process is present, the clinical manifestations of cardiovascular disease do not appear in the paediatric age-group. NAFLD is associated with increased visceral fat deposition in adults and children (Burgert et al. 2006). NAFLD was found in the Third National Health and Nutrition Examination Survey to be most prevalent in obese African-American and Hispanic males, with type 2 diabetes mellitus, hypertension, and hyperlipidemia (Meltzer and Everhart 1997). These associations have led to the hypothesis that NAFLD may precede the onset of type 2 diabetes in some individuals. Although the natural history of NAFLD in children is unknown, it may progress to cirrhosis and related complications (Feldstein et al. 2003).
Menstrual abnormalities in obese children are also common. One hypothesis suggests that the levels of body weight and fatness are the critical physiologic triggers of menarche and in fact, obese girls are observed to experience earlier menarche, typically before the age of 10 years (Frisch 1984). Late or absent menstruation is also associated with obesity. Oligomenorrhea or amenorrhea associated with obesity, insulin resistance, hirsuitism, acne and acanthosis nigricans constitutes the 'polycystic ovary syndrome.' Approximately 40 - 60% of adult women with polycystic ovary syndrome are overweight or obese (Balen et al. 1995).

2.4.1.2 Cardiovascular

Approximately 20 - 30% of obese children (weight>120% ideal) between the ages of 5-11 years have elevated systolic or diastolic blood pressure (Figueroa - Colon et al. 1997). Prospective data from the Muscatine Study (Lauer and Clarke 1989) show that obese boys and obese girls (BMI>90\textsuperscript{th} centile) are 9 to 10-fold more likely to develop high blood pressure as young adults than non-obese children. Similarly, data from the Bogalusa Heart Study (Srinivasan et al. 1996) indicate that overweight adolescents (BMI>75\textsuperscript{th} centile) are 8.5-fold more likely to have hypertension as adults than lean adolescents.
2.4.1.3 Respiratory

Among enrollees in a hospital-based weight control program, approximately 30% of the obese children suffered from asthma (Unger et al. 1990). In one study of both obese and non-obese children, more than 80% of obese children had a decrease of at least 15% in performance with exercise on one of the standard pulmonary function tests, compared to only 40% of the non-obese children (Kaplan and Montana 1993).

Sleep disorders represent another pulmonary consequence of childhood obesity. A study of 41 children with severe obesity revealed that one-third of patients reported symptoms consistent with sleep apnoea, and approximately one-third of patients had abnormal sleep studies. Two patients (5%) had evidence of severe sleep apnoea (Marcus et al. 1998). Of particular concern, are results reported by Rhodes et al in 1995, which indicate that obese children with obstructive sleep apnoea, demonstrate clinically significant decrements in learning and memory function compared to obese children without obstructive sleep apnoea.
2.4.1.4 Orthopaedic

The presence of unfused growth plates and softer cartilaginous bones of children, contributes to the occurrence of orthopaedic abnormalities in obese children. Additionally, the tensile strength of bone and cartilage did not evolve to carry substantial quantities of excess weight (Dietz 1998). Permanent damage to the femoral head may occur when dislocation occurs at the femoral growth plate (Must and Strauss 1999). The incidence of slipped capital epiphyses is approximately 3.4 per 100,000 children (Bruce 1941). Between 50-70% of patients with slipped capital epiphyses and approximately two-thirds of patients with bilateral slipped capital epiphyses are obese (Must and Strauss 1999). Furthermore, slipped capital epiphyses occur at significantly younger ages among obese children than among non-obese children (Dietz 1998). Blount's disease (tibia vara) involves bowing of the legs and tibial torsion in response to unequal or early excess weight bearing. It is often progressive and recurrent requiring multiple osteotomies. Severe infantile Blount's disease appears associated with obesity in children. Approximately 80% of the children reported by Must and Strauss in 1999 with Blount's disease were obese.
2.4.2 Psychosocial Consequence

The immediate psychosocial consequences of childhood and adolescent obesity have long been recognized. Hilde Bruch in 1941 described obesity in childhood and its association with personality development. Stigmatization and discrimination by peers is well documented. From very young ages, obese children are characterized in negative ways, less preferred by friends and more likely to be targets of teasing or bullying (Guo and Chumlea 1999). There is also some evidence of bias and stereotyping by teachers and even some parents (Puhl and Latner 2007). As a consequence of childhood obesity, depressive disorder has also been noted. In a study by Eremis et al in 2004, more than half of the clinical obese adolescents had a DSM-IV (Diagnostic and Statistical Manuel of Mental Disorder) disorder, often involving major depressive disorder. The mean scores of anxiety-depression, social problems, and social withdrawal of the clinical obese group were significantly higher than the non-clinical obese group and normal weight group.

2.5 Conclusion

As indicated by the preceding review, the prevalence of childhood obesity is increasing to epidemic proportions. Biological and social factors merge in the development of obesogenic behaviours, and the short and long-term physical and psychosocial health
consequences of obesity. Due to this, we can anticipate that the once relatively rare endocrinal, orthopaedic, pulmonary and cardiovascular consequences will become far more commonplace. At present, the metabolic syndrome is found in 4.5% of children and adolescents in population-based studies (Jessup and Harrell 2005), but in up to 49% of severely obese youth (Lobstein et al. 2004). This presents a serious threat to the current and future health of youth worldwide. The findings that one third of newly diagnosed diabetics between 10-19 years were type 2 diabetics (Rosenbloom et al. 1999), is particularly ominous. This condition, once called ‘adult onset diabetes’ may become a prevalent chronic disease of adolescence.
Chapter 3

METHODOLOGY

3.1 Introduction

The study ‘Prevalence of obesity in Maltese children aged 5 and 9 years’ is a point prevalence study, which was conducted in 2008 and early 2009. This study was divided into two parts:

1. An extensive literature review was conducted wherein obesity in childhood was reviewed. Pubmed and Google Scholar search using “childhood obesity” and review of local publications for relevant work were utilised, mainly focusing on (a) its prevalence in Malta and Europe, (b) the risk factors which may lead to obesity, and (c) the associated co-morbidities of childhood obesity including type 2 diabetes and the metabolic syndrome.

2. A study was carried out on a random sample of a total of 431 children: 220 males (51.1%) and 211 females (48.9%) representative of the target population. Body Mass Index (BMI) and waist circumference were measured from the study population. A validated questionnaire was distributed to the children included in the sample population. The questionnaire was filled out by the parents and assessed child lifestyle characteristics including physical activity, nutrition, family general
characteristics and birth weight. Only the children whose parents had completed the questionnaire with the corresponding consent form signed were measured. Both the anthropometric measurements and the variables assessed in the questionnaire were analysed to examine for any possible associations.

<table>
<thead>
<tr>
<th></th>
<th>Male population</th>
<th>Female population</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 years of age</td>
<td>123</td>
<td>113</td>
</tr>
<tr>
<td>9 years of age</td>
<td>97</td>
<td>98</td>
</tr>
</tbody>
</table>

Table 3.1 Study population

3.2 Study Design and Sample

3.2.1 Study Design

Random sampling was used to monitor the BMI and waist circumference of children representative of the Maltese population. The randomisation was carried out by randomly selecting Grade I and Grade V classes from various schools, selected according to their demographic position in the island of Malta, namely Northern and Southern areas. This sample was broken down by gender and school grade, namely the Grade I at age 5 and Grade V at age 9 years. These age groups were chosen because they precede puberty, and at these ages the identification of obesity is of value to predict the condition in adulthood (World Health Organisation. 2005). Moreover at the age of about 5 to 6 years the adiposity
rebound (onset of the second period of rapid growth in body fat) starts. An early rebound (before 5.5 yr) is followed by a significantly higher adiposity level than a later rebound (after 7 yr) (Rolland-Cachera et al. 1984). Further, it is suggested that targeting prevention efforts towards children before the onset of puberty, may be important in reducing incidence rates and promoting remission (Kim et al. 2005).

<table>
<thead>
<tr>
<th>Primary Schools</th>
<th>Male – 5 yrs</th>
<th>Female – 5 yrs</th>
<th>Male – 9 yrs</th>
<th>Female – 9 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Francis, Msida</td>
<td>20</td>
<td>21</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Msida</td>
<td>8</td>
<td>11</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Mellieha</td>
<td>20</td>
<td>6</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Mosta</td>
<td>21</td>
<td>23</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Zurrieq</td>
<td>24</td>
<td>23</td>
<td>27</td>
<td>34</td>
</tr>
<tr>
<td>Zejtun</td>
<td>30</td>
<td>29</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTALS</td>
<td>123</td>
<td>113</td>
<td>97</td>
<td>98</td>
</tr>
</tbody>
</table>

Table 3.2 Study population distribution by schools

### 3.2.2 Site and Settings

The Maltese Archipelago in the Central Mediterranean comprises a series of three inhabitable islands that together make up only 312 km$^2$. The Archipelago is highly over-populated with total population increasing from 114 449 in 1842 (population density of 362 persons per km$^2$) to 404 962 in 2005 (population density of 1298 persons per km$^2$). The birth rate in Malta is just under 4 000 per annum. The number of children aged 5 years in the last census was reported as 2 125 males and 2 188 females; while 9 year olds accounted
for 2 576 males and 2 357 females (National Statistics Office. 2007). The study population therefore accounted for 5.8% of boys and 5.2% of girls aged 5 years; and 3.8% and 4.2% respectively of children aged 9 years.

This study targeted the group that is most sensitive to environmental influences, and is showing the greatest increase in the incidence of obesity, reaching in school children a level as high as 2.0 percentage points in some countries (Jackson - Leach and Lobstein 2006). In Malta, schooling is compulsory from age 5 to age 16 years, and thus most of the children are reachable through the education system; hence schools are the best place for recruitment. Primary schooling is co-educational and spans the six years up to age 11, while secondary school is single-sex, and continues up to age 16. There are three types of schools: state, private and church schools. Any child can attend state primary schools, while those who attend church schools are drawn by lot. Entrance into private schools depends on space available and involves paying trimester fees. State schools usually cater for students from that particular locality, while church and private schools cater for students from any locality.

3.2.3 Sampling Design

The majority of the children in specific age groups i.e. 5.0-5.9 years and 9.0-9.9 years correspond to two school grades. Thus, once all the children of the specifically
targeted age groups were all in the same grade, a sample was drawn within a grade level, after specific schools were selected according to various regions. A total of six schools were selected i.e. five state and one church school. The regions were divided into two main areas i.e. the Northern and Southern areas of the island of Malta. The areas of Mellieha and Mosta were considered to lie in the northern area of the island while Msida, Zejtun and Zurrieq were considered to lie in the southern area of the island. The island of Gozo was not included in this study. This sample design was a cluster random sample, where the cluster or primary sampling unit was the various classes of Grade I and Grade V.

Cluster random sampling is a method of performing population surveys through the selection of different clusters. Current existing clusters from the population can be easily utilized for sampling, and data can be collected conveniently because of appropriate and concentrated units in population surveys (Ye 1983).

3.2.4 Sample Size

To calculate the sample size the overweight and obesity rates for both age groups i.e. 5 and 9 year old in Maltese children was used. The reported 2006 prevalence rate of overweight and obese Maltese children aged 5 years amounts to 25% (Grech and Farrugia Sant'Angelo 2009); while the rate in Maltese 9 year old children was reported to be at 38.5% (Janssen et al. 2005). The total number of children aged 5 years and 9 years
respectively, in the 2005 national census amounted to 4,313 and 4,933 respectively (National Statistics Office, 2007). Using Pi Face as a statistical package to assess sample size, a total of 199 participants were found to be required in each group, to ensure a 90% confidence limit.

3.3 Data Collection

3.3.1 Data Collection Form

A previously validated questionnaire was used with the kind permission of the WHO Regional Office for Europe (Appendix C). This questionnaire is currently being used for the WHO European Childhood Obesity Surveillance Initiative. A covering letter in both English and Maltese accompanied the questionnaire (Appendix A and B respectively). This explained to the parents of the children, the purpose and importance of the proposed study, and included a consent form for them to sign if they wished their child to participate in the study. The data collection form was also translated into Maltese (Appendix D) and back translated to English. The translated forms were carefully checked for discrepancies with the original English version. Questionnaires in both English and Maltese were distributed. The questionnaire included close-ended questions and was as short as possible to improve responsiveness and sample retention.
In addition to the anthropometric measures, data was obtained on simple indicators of the children's dietary intake and physical activity/inactivity patterns, since optimization of diet and increasing physical activity are key objectives in combating the obesity epidemic. The questionnaire also included the birth weight of the child, so that any association with the child's present weight could be assessed. Further, the family socioeconomic characteristics and co-morbidities were also obtained.

The questionnaires were distributed in sealed envelopes to the various classes by the headmaster or headmistress of the schools chosen to participate, and they were responsible for their collection after a stipulated time interval of two weeks.

3.3.2 Measurements

For children and adolescents, there are different methods of diagnosing overweight and obesity. In the past, obesity has been defined as a visible excess of body fat. However, the main uncertainty in this definition was the understanding of how much an excess of body fat was. Clinically evident obesity can be diagnosed easily, even by people not expert in the field, but overweight as a risk factor of ill health is not easy to diagnose. Fat mass increases in terms of absolute values with age, but its ratio with height and weight physiologically varies and it varies differently in the two sexes, making more problematic the definition of its excess as total amount and as percentage (Caroli et al. 2007).
The ideal method to assess overweight or obesity should accurately calculate the fat mass, be independent of other covariates of body mass such as height, be acceptable and reproducible, and have low costs and appropriate values of normality (Power et al. 1997). *In vivo* it is not possible to directly measure body fat. Thus, several indirect methods have been developed (e.g. underwater weighing, dual energy x-ray absorptiometry) to evaluate body composition and specifically the total fat mass (Reilly et al. 1995) (Pietrobelli et al. 1998). However, many of these laboratory indirect methods are expensive, require special equipment, and are thus inadequate for use in public health and in children.

Anthropometric measurements are less accurate for measuring the excess of body fat than the indirect laboratory methods, but are more practical and easy to use in surveying childhood obesity. The most utilised are subcutaneous skin fold thicknesses, height, weight – in different ratios – and body circumferences (Caroli et al. 2007). In this study, measurement of subcutaneous skin fold was not utilized. The ratio between subcutaneous and total body fat is not constant but varies with race, sex and age (Wells 2001), and subcutaneous fat is not related to a risk of metabolic complications, as in the case of visceral fat (Freedman et al. 1999). The main difficulty in using skin fold thickness is the standardization of skin fold measurement, which shows a high inter-operator variability (Wells 2001). The anthropometric measurements used in this study were:
1. Body Mass Index
2. Height
3. Waist circumference.

3.3.2.1 Standardization of Conditions

Weight, height and waist circumference measurements were performed by the school nurse. Each child was measured one at a time. Prior to the period of data collection, the school nurse was instructed on standard procedures of the anthropometric measurements.

Measurement of the children commenced in mid-December 2008 and was completed during a timeframe of 6 weeks. All measurements were done in the morning before lunch time and the children were asked to go to the toilet prior to being measured. Children can be very sensitive about their own size and those of children around them. Anthropometric measurements could accentuate these sensitivities and increase the risk of stigmatization and bullying. Words such as “childhood obesity” were never mentioned in front of the children, and no indication was given that this data collection referred to the assessment of the prevalence of overweight and obesity in school children. Children were never told the measurements of other children and only told of their own when they asked.
3.3.2.2 Instruments

Measurements of height and weight were performed with a portable stadiometer (SECA 214 Portable Stadiometer) and portable digital scales (BUERER PS07 Digital Weighing Scales). The weighing scale and the stadiometer were checked and calibrated on each day that measurements were to take place. The weighing scale was checked and calibrated if necessary by using standard metal brass weights of 10kg, 20kg and 25kg. The stadiometer was checked and calibrated if necessary by using a polyvinyl rod of known length i.e. 100 cm. A non-elastic metal tape with blank lead-in was used for measurement of the waist circumference.

3.3.2.3 Measurement Techniques

3.3.2.3.1 Body Weight

To measure weight a portable electronic (digital reading) scale that was calibrated to 0.1 kg and measured up to 150 kg was used. This apparatus was easy to use and transport. Observer measurement error was reduced as the weight was electronically displayed. The children’s body weight was measured in kilograms and recorded to the nearest 100 gram
unit (0.1 kg). Before measuring the body weight, the children were asked to take off their shoes, as well as all heavy clothing (coats, sweaters, jackets, etc). The children during measurement wore a shirt, trousers or skirt and socks. The children were asked to stand in the middle of the scale, feet slightly apart and to remain still until the weight appeared on the screen.

3.3.2.3.2 Body Height

To measure body height a stadiometer was used. The children’s height was measured in centimetres and the reading was taken to the last completed 1 millimetre (mm) (0.1 cm). Height was measured standing upright without shoes. Each child was helped to stand on the baseboard with feet slightly apart and against the vertical backboard. Shoulders were kept level and hands at the side. Legs were kept straight and feet flat. The child’s head was positioned so that a horizontal line from the ear canal to the lower border of the eye socket ran parallel to the baseboard.

3.3.2.3.3 Waist Circumference

The children’s waist circumference was measured in centimetres and recorded to the last completed millimetre (mm) (0.1 cm). The child was asked to stand with the
abdomen relaxed, the arms at the sides and the feet pointing forward and together. The child was asked if s/he agreed to lower the pants and underclothing slightly. The level at which waist circumference was measured was just above the uppermost lateral border of the right ilium, at the end of normal gentle expiration, without the tape compressing the skin.

3.3.2.4 Anthropometric Indices

Body weight and body height are easy to measure, however, the anthropometric indices derived from these measures are often considered more useful than the measures alone (World Health Organisation. 1995). In this study the Body Mass Index was used. This is calculated as weight (kg) divided by height squared (m²). For children, BMI is a well recognized measure to determine whether a child may be underweight, normal weight, at risk for overweight, overweight, or obese. In adults, excess body weight is defined as having a BMI ≥ 25kg/m². Obesity is defined as a BMI ≥ 30kg/m². BMI is recommended to be used for monitoring the response of individual overweight and obese children, and adolescents to exercise and modifications in diet. It is also used for assessing the need to continue, modify or discontinue efforts to promote such actions, as well as for nutritional surveillance to assess the risk of overweight and obesity, in order to modify programmes and allocate resources (World Health Organisation. 1995). BMI is more accurate when body height and weight are measured by a trained person than self reporting or reported by parents. Subjects tend to under report their body weight (especially the obese) and tend to
over report body height (Dekkers et al. 2008). BMI also has some limitations, for instance it provides only a crude measure of body fatness, since it does not distinguish between body weight associated with muscle, and body weight associated with fat (World Health Organisation. 2000). The measurement of abdominal fat is important, since an excess of abdominal fat (independently of total body fat) is associated with metabolic abnormalities, such as hyperinsulinemia and dyslipidemia (Freedman et al. 1999). Taylor et al., in 2000 reported that the conicity index (evaluation of waist circumference in relation to body height and weight) was not as accurate a measure of central adiposity, as is the waist circumference in children.

3.3.2.5 Reference Values and Cut Off Points

3.3.2.5.1 Body Mass Index

Several national BMI for age curves have been developed for boys and girls separately (Must et al. 1991); (Cole et al. 1995); (Rolland-Cachera et al. 1991). The growth pattern of a single country cannot be considered as a gold standard, against which to compare all others, because it is not possible to indicate which country should be considered as the gold standard. National curves, thus will only allow an intra-country comparison over time or by region, but cannot be used to compare between countries. In 2000, Cole and his co-workers designed a growth reference for children and adolescents, aged 2-18 years for use in international comparisons of the prevalence of overweight and
obesity. These new international standard definitions are based on six large, nationally representative cross-sectional growth studies from birth to 25 years (Brazil 1989, Great Britain 1979-1993, Hong Kong 1993, the Netherlands 1980, Singapore 1993, and the United States 1963-1980). The centile curves of BMI were drawn in a way, that at age 18, these passed through the BMI cut off points of 25 kg/m² and 30 kg/m², for adult overweight and obesity, respectively. A centile curve for each country that took part in the study was created. The resultant curves were averaged to provide age and sex specific BMI cut off points, to define overweight (25kg/m²) and obesity (30kg/m²) in half-year intervals from 2 to 18 years. These cut off points have been used in this study to determine overweight and obesity in the study subjects.

<table>
<thead>
<tr>
<th>Population group</th>
<th>Overweight Equivalent to 25 kg/m² in adults</th>
<th>Obese Equivalent to 30 kg/m² in adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>5yr old boys</td>
<td>17.42</td>
<td>19.30</td>
</tr>
<tr>
<td>5yr old girls</td>
<td>17.15</td>
<td>19.17</td>
</tr>
<tr>
<td>9yr old boys</td>
<td>19.10</td>
<td>22.17</td>
</tr>
<tr>
<td>9yr old girls</td>
<td>19.07</td>
<td>22.18</td>
</tr>
</tbody>
</table>

Table 3.3: International cut off points for body mass index for overweight and obese by sex for ages of 5 and 9 years (Cole et al. 2000)

3.3.2.5.2 Waist Circumference

To date waist percentile curves have been developed for English, Italian, Cuban, Spanish and European-American children (McCarthy et al. 2001); (Zannolli and Morgese
So far, no international agreement has been decided on a common agreed site of measurement. Due to this, cross-cultural comparisons cannot be made. The European-American percentile curves established by Fernández et al in 2004 were used in this study as they are the closest methodologically. In this study, children whose waist circumference, fell above the 75th percentile for age were considered to be overweight or obese.

<table>
<thead>
<tr>
<th>Percentile for boys</th>
<th>Percentile for girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 10th</td>
<td>25th</td>
</tr>
<tr>
<td>5 yr</td>
<td>48.3</td>
</tr>
<tr>
<td>9 yr</td>
<td>55.5</td>
</tr>
</tbody>
</table>

Table 3.4: Waist cut off points for percentile regression for ages of 5 and 9 years (Fernández et al. 2004)

3.4 Data Analysis

- On calculation of the BMI the school children were divided into 3 groups: lean, overweight and obese, using the international standard definitions of overweight and obesity devised by Cole et al in 2000.

- The separate groups of children as according to age and gender were compared to each of the variables, namely waist circumference, family history of metabolic
disease, breastfeeding, birth weight, socio-economic status, physical exercise and nutrition.

- The collected data was statistically analyzed using appropriate statistical tests to examine any correlation between the BMI and the investigated variables. Both the Student’s t-test which was utilized to compare the means of two samples and the Chi - squared test which was utilized to compare two populations were used in this study.

3.5 Ethical Considerations

After a meeting with the University Research Ethics Committee of the University of Malta in September 2008, the protocol of this study was approved. The relative permission was also granted from the Education Department of Malta, so the study could be performed in state, church, and private schools. The headmasters of all the schools in which the proposed study was to be held were also informed and their permission was also granted. A consent form was sent to all the parents of the children taking part in the study. These consent forms were both in English and Maltese (Appendix A and B respectively). Parents were fully informed about all the objectives of this study and the study procedures. Their informed consent for the measurements and for data treatment was obtained on a voluntary basis. Only the children of the parents who gave their consent were measured.
Confidentiality of all collected and archived data was ensured. Identification numbers to the children were assigned and each register only mentioned those numbers. Only the researcher has a full list of identification numbers, and corresponding names and addresses of the children sampled. No information of the subjects was given to outside people. Anonymity was maintained at all times and the children’s names were not included in the electronic data files.

Parents have the right to know their child’s measures. Although these were not given routinely, they were given if requested by the parents. Children or parents were never told the measures of other children. It was vital, that the examiners worked in such a way that stigmatization and bullying was minimized, and that they acknowledged the children’s and parent’s right to withhold consent.
Chapter 4

RESULTS

4.1 Introduction

A total of 688 questionnaires were distributed to various Grade I classes with children aged 5 years, and Grade V classes with children aged 9 years in six selected schools, from the different regions in Malta. The study population included a total of 431 children recruited from the different schools. The overall response rate thus reached 62.65%. The response rate varied between the different schools (Table 4.1.1). The school with the highest response rate was St. Frances School of Msida with a response rate of 81.30%, while the lowest was that for Zurrieq Primary School, with a response rate of 52.69%.

<table>
<thead>
<tr>
<th>Locality</th>
<th>Male Grade I (5yr)</th>
<th>Female Grade I (5yr)</th>
<th>Response rate [%]</th>
<th>Male Grade V (9yr)</th>
<th>Female Grade V (9yr)</th>
<th>Response Rate [%]</th>
<th>(9yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Francis, Msida</td>
<td>20</td>
<td>21</td>
<td>78.85</td>
<td>24</td>
<td>22</td>
<td>83.36</td>
<td></td>
</tr>
<tr>
<td>Msida</td>
<td>8</td>
<td>11</td>
<td>48.71</td>
<td>12</td>
<td>8</td>
<td>62.50</td>
<td></td>
</tr>
<tr>
<td>Mellieha</td>
<td>20</td>
<td>6</td>
<td>44.07</td>
<td>14</td>
<td>15</td>
<td>60.42</td>
<td></td>
</tr>
<tr>
<td>Mosta</td>
<td>21</td>
<td>23</td>
<td>73.33</td>
<td>20</td>
<td>19</td>
<td>69.64</td>
<td></td>
</tr>
<tr>
<td>Zurrieq</td>
<td>24</td>
<td>23</td>
<td>61.04</td>
<td>27</td>
<td>34</td>
<td>52.69</td>
<td></td>
</tr>
<tr>
<td>Zejtun</td>
<td>30</td>
<td>29</td>
<td>62.76</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>123</td>
<td>113</td>
<td>61.94</td>
<td>97</td>
<td>98</td>
<td>63.52</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1.1: Population data by various schools
The gender and age distribution of the eventual study population is outlined in Table 4.1.2. The study population at aged 5 years accounted for 4.5% of the total 5 year old child population registered in Malta in the National Census conducted in 2005. The corresponding proportion for children aged 9 years was 3.9%.

<table>
<thead>
<tr>
<th>Population</th>
<th>Grade I classes</th>
<th>Grade V classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Children aged 5 years</td>
<td>Children aged 9 years</td>
</tr>
<tr>
<td>Study Population</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male gender</td>
<td>123</td>
<td>97</td>
</tr>
<tr>
<td>Female Gender</td>
<td>113</td>
<td>98</td>
</tr>
<tr>
<td>Male:Female ratio</td>
<td>1.09</td>
<td>0.99</td>
</tr>
<tr>
<td>2005 Census Population</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male gender</td>
<td>2714</td>
<td>2654</td>
</tr>
<tr>
<td>Female gender</td>
<td>2535</td>
<td>2311</td>
</tr>
<tr>
<td>Male:Female ratio</td>
<td>1.07</td>
<td>1.15</td>
</tr>
<tr>
<td>Statistical difference</td>
<td>0.96 NS</td>
<td>0.35 NS</td>
</tr>
</tbody>
</table>

Table 4.1.2: Study and 2005 Census population by age and gender

4.2 Children Anthropomorphic Characteristics

The prevalence of childhood overweight in Maltese 5 year old children based on cut-off points defined in the literature (Cole et al. 2000), was 18.2% for boys and 18.3% for girls. The respective prevalence rates of obese 5 year old children were 10.6% and 14.4%. There was no statistically significant difference in the Body Mass Index (BMI) distribution between the genders \( p = 0.70 \) (Table 4.2.1). These proportions increased markedly with
increasing age, so that 20.6% of Maltese 9 year old males and 25.3% of girls were found to be overweight. The respective prevalence rates of obese 9 year old children were 28.3% and 19.8%. There was no statistically significant difference between the genders ($p = 0.39$) (Table 4.2.2).

<table>
<thead>
<tr>
<th>BMI (Kg/m$^2$)</th>
<th>Population (n)</th>
<th>Population (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males &lt;17.42</td>
<td>74</td>
<td>71.2</td>
</tr>
<tr>
<td>Females &lt;17.15</td>
<td>70</td>
<td>67.3</td>
</tr>
<tr>
<td>Overweight:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males 17.42-19.30</td>
<td>19</td>
<td>18.2</td>
</tr>
<tr>
<td>Females 17.15-19.17</td>
<td>19</td>
<td>18.3</td>
</tr>
<tr>
<td>Obese:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males &gt;19.30</td>
<td>11</td>
<td>10.6</td>
</tr>
<tr>
<td>Females &gt;19.17</td>
<td>15</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Table 4.2.1: BMI distribution at age 5 years by gender (definitions based on literature)

<table>
<thead>
<tr>
<th>BMI (Kg/m$^2$)</th>
<th>Population (n)</th>
<th>Population (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males &lt;19.10</td>
<td>47</td>
<td>51.1</td>
</tr>
<tr>
<td>Females &lt;19.07</td>
<td>50</td>
<td>54.9</td>
</tr>
<tr>
<td>Overweight:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males 19.10-22.77</td>
<td>19</td>
<td>20.6</td>
</tr>
<tr>
<td>Females 19.07-22.10</td>
<td>23</td>
<td>25.3</td>
</tr>
<tr>
<td>Obese:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males &gt;22.77</td>
<td>26</td>
<td>28.3</td>
</tr>
<tr>
<td>Females &gt;22.10</td>
<td>18</td>
<td>19.8</td>
</tr>
</tbody>
</table>

Table 4.2.2: BMI distribution at age 9 years by gender (definitions based on literature)
The sample population of five year olds had a mean BMI averaging 16.7 kg/m², while the waist circumference averaged 54.4 cm. The average weight was 20.6 kg, while the mean height for both genders was 1.11 m. There were no significant differences on the various parameters between genders (Table 4.2.3).

The sample population of nine year olds had a mean BMI averaging 19.6 kg/m² while the waist circumference averaged 65.5 cm. The average weight was 36.0 kg, while the mean height for both genders 1.35 m. The mean BMI of the sample population differed markedly between the genders though the difference did not reach statistical significance. This non-statistical difference is reflected in the overall weight difference. The genders did however exhibit a statistically significant difference in their waist circumference ($p = 0.004$) (Table 4.2.4).

<table>
<thead>
<tr>
<th>Anthropomorphic characteristics</th>
<th>Female – 5 yrs</th>
<th>Male – 5 yrs</th>
<th>Significance [Student t test]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± s.d.</td>
<td>Mean ± s.d.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[n]</td>
<td>[n]</td>
<td></td>
</tr>
<tr>
<td>Waist circumference [cm]</td>
<td>54.57 ± 8.06</td>
<td>54.20 ± 4.69</td>
<td>$P = 0.692$ ns</td>
</tr>
<tr>
<td>[92]</td>
<td>[103]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI [kg/m²]</td>
<td>16.66 ± 2.24</td>
<td>16.65 ± 2.16</td>
<td>$P = 0.975$ ns</td>
</tr>
<tr>
<td>[92]</td>
<td>[104]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>20.60 ± 3.95</td>
<td>20.58 ± 3.69</td>
<td>$P = 0.970$ ns</td>
</tr>
<tr>
<td>[92]</td>
<td>[105]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height [m]</td>
<td>1.11 ± 0.05</td>
<td>1.11 ± 0.05</td>
<td>$P = 1.0$ ns</td>
</tr>
<tr>
<td>[92]</td>
<td>[104]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.2.3: Anthropomorphic characteristics by gender – 5 years of age
Table 4.2.4: Anthropomorphic characteristics by gender – 9 years of age

<table>
<thead>
<tr>
<th>Anthropomorphic characteristics</th>
<th>Female – 9 yrs Mean ± s.d. [n]</th>
<th>Male – 9 yrs Mean ± s.d. [n]</th>
<th>Significance [Student t test]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waist circumference [cm]</td>
<td>63.24 ± 9.18 [92]</td>
<td>67.78 ± 11.59 [92]</td>
<td>$P = 0.004$ sig</td>
</tr>
<tr>
<td>BMI [kg/m²]</td>
<td>19.07 ± 3.81 [92]</td>
<td>20.18 ± 4.60 [93]</td>
<td>$P = 0.076$ ns</td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>34.87 ± 9.1 [92]</td>
<td>37.16 ± 10.15 [93]</td>
<td>$P = 0.108$</td>
</tr>
<tr>
<td>Height [m]</td>
<td>1.35 ± 0.08 [92]</td>
<td>1.35 ± 0.06 [93]</td>
<td>$P = 1.0$ ns</td>
</tr>
</tbody>
</table>

4.3 Risk Factors

A number of risk factors have been identified as being contributory in the development of childhood obesity. Many of these have been analysed in the Maltese childhood population in the present study.

4.3.1 Genetic and Biological Factors

There appeared to be an indication that there is an increasing tendency for a positive association between family history of metabolic disease (a history of hypertension or diabetes mellitus in either or both of the parents) and childhood obesity at both age groups studied. However, the observations did not show statistical significance (Table 4.3.1.1).
<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Lean (n)</th>
<th>Lean(%)</th>
<th>Overweight – Obese (n)</th>
<th>Overweight – Obese (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td>5-yr-old population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family History of Metabolic Disease</td>
<td>No</td>
<td>116</td>
<td>80.6</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>28</td>
<td>19.4</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$P = 0.40 \text{ ns}$</td>
<td></td>
</tr>
<tr>
<td>9-yr-old population</td>
<td>No</td>
<td>68</td>
<td>70.8%</td>
<td>89</td>
</tr>
<tr>
<td>Family History of Metabolic Disease</td>
<td>Yes</td>
<td>28</td>
<td>29.2%</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$P = 0.57 \text{ ns}$</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.1.1 Family history by BMI
* Chi Square statistical test

4.3.2 Early Metabolic Imprinting

There did not appear to be any significant difference in mean birth weights of children between lean and overweight-obese children at both age groups. However, the overweight-obese group in 5 year olds did appear to have an overall higher mean birth weight (Table 4.3.2.1). There did appear to be a statistically significant relationship between the development of overweight-obesity in 5 year old children and a history of breastfeeding. While the observation persisted in the 9 year old children, the differences were not statistically significant in this age group (Table 4.3.2.1/Figure 4.3.2.1).
<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Lean</th>
<th>Overweight – Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td>5-yr-old population Birth weight [g] 3088.87 ± 624.30 [135]</td>
<td>3259.70 ± 622.86 [60]</td>
</tr>
<tr>
<td></td>
<td>9-yr-old population Birth weight [g] 3322.25 ± 452.64 [35]</td>
<td>3391.90 ± 642.31 [79]</td>
</tr>
<tr>
<td></td>
<td>5-yr-old population Breastfeeding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No</td>
<td>51 36.7%</td>
</tr>
<tr>
<td></td>
<td>• Yes</td>
<td>88 63.3%</td>
</tr>
<tr>
<td></td>
<td>9-yr-old population Breastfeeding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No</td>
<td>29 30.2%</td>
</tr>
<tr>
<td></td>
<td>• Yes</td>
<td>67 69.8%</td>
</tr>
</tbody>
</table>

Table 4.3.2.1: Metabolic imprinting determinants by BMI

* Student statistical test
* Chi Square statistical test

Figure 4.3.2.1: Bottle-feeding rates by current body weight status in 5 and 9-year olds
4.3.3 Birth Weight Correlations

As noted above, the birth weight of the child may appear to contribute towards the likelihood of eventually developing obesity. The overall mean birth weight in the male sample in the study population was $3151.3 \pm 668.9$ g ($n = 205$); while the overall mean birth weight in the female population was $3224.2 \pm 631.3$ g ($n = 192$). There was no statistically significant differences in the birth weights between the genders ($p = 0.27$).

It would appear that there is a progressive increase in anthropomorphic mean measures determined by weight at birth, when assessed in the 5 year old children. However, the large majority of these differences did not exhibit statistical significance. The mean body weight of children born with a birth weight under 2500 g, was statistically lower than that registered for infants born with a weight of 2500-3999 g (Table 4.3.3.1 / Figure 4.3.3.1). There were similarly no statistically significant differences between birth weight and anthropomorphic characteristics, when the BMI and waist circumference, for the combined male and female population were classified according to defined parameters (Table 4.3.3.2).
### Table 4.3.3.1: Mean Anthropomorphic values at 5-years of age by birth weight

*Student statistical tests compared to group with birth weight 2500-3999 g.*

<table>
<thead>
<tr>
<th>Birth weight [g]</th>
<th>&lt;2500</th>
<th>2500-3999</th>
<th>≥4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI [kg/m²]</td>
<td>16.1 ± 2.0 [21]</td>
<td>16.7 ± 2.2 [161]</td>
<td>17.5 ± 2.7 [13]</td>
</tr>
<tr>
<td></td>
<td><em>P = 0.24 ns</em></td>
<td></td>
<td><em>P = 0.22 ns</em></td>
</tr>
<tr>
<td></td>
<td><em>P = 0.002 sig</em></td>
<td></td>
<td><em>P = 0.08 ns</em></td>
</tr>
<tr>
<td>Waist circumference [cm]</td>
<td>52.7 ± 3.7 [20]</td>
<td>54.7 ± 7.0 [161]</td>
<td>55.5 ± 5.4 [13]</td>
</tr>
<tr>
<td></td>
<td><em>P = 0.21 ns</em></td>
<td></td>
<td><em>P = 0.69 ns</em></td>
</tr>
<tr>
<td>Height [m]</td>
<td>1.1 ± 0.1 [21]</td>
<td>1.1 ± 0.05 [161]</td>
<td>1.1 ± 0.05 [13]</td>
</tr>
<tr>
<td></td>
<td><em>P = 1.0 ns</em></td>
<td></td>
<td><em>P = 1.0 ns</em></td>
</tr>
</tbody>
</table>

### Table 4.3.3.2: Distribution of Anthropomorphic values at 5-years of age by birth weight

*Chi-square statistical tests.*

<table>
<thead>
<tr>
<th>Birth weight [g]</th>
<th>&lt;2500</th>
<th>2500-3999</th>
<th>≥4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI [kg/m²]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Lean</td>
<td>11</td>
<td>104</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>68.7%</td>
<td>80.6%</td>
<td>8.0%</td>
</tr>
<tr>
<td>• Overweight/obese</td>
<td>5</td>
<td>25</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>31.3%</td>
<td>19.4%</td>
<td>92.0%</td>
</tr>
<tr>
<td></td>
<td><em>P = 0.98 ns</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist circumference [cm]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• &lt;75th centile</td>
<td>15</td>
<td>116</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>78.9%</td>
<td>72.0%</td>
<td>76.9%</td>
</tr>
<tr>
<td>• &gt;75th centile</td>
<td>4</td>
<td>45</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>21.1%</td>
<td>28.0%</td>
<td>23.1%</td>
</tr>
<tr>
<td></td>
<td><em>P = 0.77 ns</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
At nine years of age, there appeared to be an increase in the anthropomorphic measures, in both the infants born with a weight of <2 500g and those born with a weight of 4 000g or more, when compared to infants born with a weight of 2 500-3 999g. Statistical significance was shown only for the higher birth weight group (Table 4.3.3.3 / Figure 4.3.3.1). Similar statistically significant observations can be made, when the data is grouped according to the literature-defined parameters for BMI and waist circumference centiles. A higher BMI and waist circumference is noted in infants with a low [<2 500 g] and a high birth weight [>4 000 g]. Children with high birth weight also appear to be marginally taller (Table 4.3.3.4).

<table>
<thead>
<tr>
<th>Birth weight [g]</th>
<th>&lt;2500</th>
<th>2500-3999</th>
<th>≥4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI [kg/m²]</td>
<td>21.3 ± 5.3</td>
<td>19.2 ± 4.0</td>
<td>22.5 ± 4.7</td>
</tr>
<tr>
<td>[9]</td>
<td>[18]</td>
<td>[135]</td>
<td>[P = 0.14 ns]</td>
</tr>
<tr>
<td>Body weight [kg]</td>
<td>38.1 ± 13.3</td>
<td>35.2 ± 9.2</td>
<td>42.0 ± 9.0</td>
</tr>
<tr>
<td>[9]</td>
<td>[135]</td>
<td>[18]</td>
<td>[P = 0.38 ns]</td>
</tr>
<tr>
<td>Waist circumference [cm]</td>
<td>67.2 ± 11.1</td>
<td>64.6 ± 10.9</td>
<td>71.6 ± 8.1</td>
</tr>
<tr>
<td>[9]</td>
<td>[134]</td>
<td>[18]</td>
<td>[P = 0.49 ns]</td>
</tr>
<tr>
<td>Height [m]</td>
<td>1.3 ± 0.1</td>
<td>1.3 ± 0.1</td>
<td>1.4 ± 0.1</td>
</tr>
<tr>
<td>[9]</td>
<td>[135]</td>
<td>[18]</td>
<td>[P = 1.0 ns]</td>
</tr>
</tbody>
</table>

Table 4.3.3.3: Mean Anthropomorphic values at 9-years of age by birth weight

*Student statistical tests compared to group with birth weight 2500-3999 g.
Table 4.3.3.4 Distribution of Anthropomorphic values at 9-years of age by birth weight

*Chi-square statistical tests*

Figure 4.3.3.1: Mean BMI by birth weight in the two age groups

At the age of five years, children born of low birth weight appeared to have a statistically lower sleeping time per week than their higher weight counterparts. This translates into more time devoted to active and passive activities (Table 4.3.3.5 / Figure 4.3.3.2). At nine years of age, infants of high birth weight appear to have a statistically
lower sleeping time per week than their lower weight counterparts, while infants of low birth weight appear to have a lower physical activity time per week than their higher weight counterparts (Table 4.3.6). The physical activity in the low birth group was also markedly decreased ($5.0 \pm 4.4$ vs $13.4 \pm 6.7$: $p = 0.002$) in the nine year olds when compared to the five year olds.

<table>
<thead>
<tr>
<th>Birth weight [g]</th>
<th>&lt;2500</th>
<th>2500-3999</th>
<th>≥4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active physical activity [hrs/wk]</td>
<td>$13.4 \pm 6.7$ [26]</td>
<td>$11.0 \pm 5.7$ [184]</td>
<td>$8.9 \pm 4.1$ [13]</td>
</tr>
<tr>
<td>$P = 0.05$ sig</td>
<td>$P = 0.19$ ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive sitting activity [hrs/wk]</td>
<td>$25.1 \pm 5.8$ [25]</td>
<td>$20.8 \pm 7.9$ [184]</td>
<td>$21.1 \pm 9.4$ [13]</td>
</tr>
<tr>
<td>$P = 0.009$ sig</td>
<td></td>
<td>$P = 0.90$ ns</td>
<td></td>
</tr>
<tr>
<td>Sleep [hrs/wk]</td>
<td>$63.8 \pm 6.4$ [26]</td>
<td>$67.5 \pm 5.8$ [184]</td>
<td>$69.2 \pm 6.6$ [13]</td>
</tr>
<tr>
<td>$P = 0.003$ sig</td>
<td>$P = 0.31$ ns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.3.5: Mean activity patterns at 5-years of age by birth weight

* Student statistical tests compared to group with birth weight 2500-3999 g.

<table>
<thead>
<tr>
<th>Birth weight [g]</th>
<th>&lt;2500</th>
<th>2500-3999</th>
<th>≥4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active physical activity [hrs/wk]</td>
<td>$5.0 \pm 4.4$ [8]</td>
<td>$8.4 \pm 4.8$ [137]</td>
<td>$8.3 \pm 5.0$ [19]</td>
</tr>
<tr>
<td>$P = 0.053$ sig</td>
<td>$P = 0.93$ ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive sitting activity [hrs/wk]</td>
<td>$24.2 \pm 11.0$ [9]</td>
<td>$26.6 \pm 7.2$ [135]</td>
<td>$26.1 \pm 5.8$ [18]</td>
</tr>
<tr>
<td>$P = 0.35$ ns</td>
<td></td>
<td>$P = 0.78$ ns</td>
<td></td>
</tr>
<tr>
<td>Sleep [hrs/wk]</td>
<td>$63.7 \pm 6.6$ [8]</td>
<td>$63.5 \pm 5.4$ [143]</td>
<td>$59.5 \pm 14.4$ [19]</td>
</tr>
<tr>
<td>$P = 0.92$ ns</td>
<td></td>
<td>$P = 0.02$ sig</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.3.6: Mean activity patterns at 9-years of age by birth weight

* Student statistical tests compared to group with birth weight 2500-3999 g.
4.3.4 Socio-Economic Status

There did not appear to be any significant relationships between socio-economic parameters and the tendency towards childhood obesity in 5 year olds. On the other hand, there did appear to be a non-statistically significant reduced risk when both parents were gainfully employed, compared to when none or only one of the parents was gainfully employed. A possible reduced risk of childhood obesity at 5 years of age was also noted in families whose parents had achieved a higher educational status (Table 4.3.4.1). Similar observations can be made for the nine year old population (Table 4.3.4.2).
<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Lean</th>
<th>Overweight – Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household size</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤3</td>
<td>36</td>
<td>26.1%</td>
</tr>
<tr>
<td>4</td>
<td>65</td>
<td>47.1%</td>
</tr>
<tr>
<td>≥5</td>
<td>37</td>
<td>26.8%</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>37.3%</td>
</tr>
<tr>
<td>21</td>
<td>35.6%</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>27.1%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P = 0.23 ns</td>
<td></td>
</tr>
<tr>
<td>Single adult household</td>
<td>12</td>
<td>8.7%</td>
</tr>
<tr>
<td>Total</td>
<td>138</td>
<td>59</td>
</tr>
<tr>
<td>Maternal educational status</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1° - 2°</td>
<td>109</td>
<td>76.8%</td>
</tr>
<tr>
<td>3° or more</td>
<td>33</td>
<td>23.2%</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>78.7%</td>
</tr>
<tr>
<td>13</td>
<td>21.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P = 0.91 ns</td>
<td></td>
</tr>
<tr>
<td>Paternal educational status</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1° - 2°</td>
<td>111</td>
<td>78.7%</td>
</tr>
<tr>
<td>3° or more</td>
<td>30</td>
<td>21.3%</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>79.7%</td>
</tr>
<tr>
<td>12</td>
<td>20.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P = 0.97 ns</td>
<td></td>
</tr>
<tr>
<td>Employment status</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2</td>
<td>1.4%</td>
</tr>
<tr>
<td>One parent</td>
<td>77</td>
<td>55.4%</td>
</tr>
<tr>
<td>Both parents</td>
<td>60</td>
<td>43.2%</td>
</tr>
<tr>
<td>Kg</td>
<td>35</td>
<td>59.3%</td>
</tr>
<tr>
<td>Lb</td>
<td>22</td>
<td>37.3%</td>
</tr>
<tr>
<td></td>
<td>P = 0.54 ns</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.4.1: Socio-economic parameters by BMI at 5 years of age

* Chi Square statistical test
### Table 4.3.4.2: Socio-economic parameters by BMI at 9-years of age

<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Lean</th>
<th>Overweight – Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males &amp; Females</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤3</td>
<td>18</td>
<td>18.9%</td>
</tr>
<tr>
<td>4</td>
<td>47</td>
<td>49.5%</td>
</tr>
<tr>
<td>≥5</td>
<td>30</td>
<td>31.6%</td>
</tr>
<tr>
<td>Single adult household</td>
<td>11</td>
<td>11.6%</td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>86</td>
</tr>
<tr>
<td>Maternal educational status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1° - 2°</td>
<td>77</td>
<td>81.1%</td>
</tr>
<tr>
<td>3° or more</td>
<td>18</td>
<td>18.9%</td>
</tr>
<tr>
<td>Paternal educational status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1° - 2°</td>
<td>74</td>
<td>80.4%</td>
</tr>
<tr>
<td>3° or more</td>
<td>18</td>
<td>19.6%</td>
</tr>
<tr>
<td>Employment status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>4</td>
<td>4.2%</td>
</tr>
<tr>
<td>One parent</td>
<td>55</td>
<td>58.5%</td>
</tr>
<tr>
<td>Both parents</td>
<td>35</td>
<td>37.2%</td>
</tr>
</tbody>
</table>

* Chi Square statistical test

4.3.5 Physical Activity

Though all parameters relating to physical activity proved to have no statistical significance; it would appear that overweight and obese individuals at both age groups
report less mean active physical activity time than their leaner counterparts. In contrast, sleeping time is also apparently less in the overweight and obese groups. However, there appeared to be a marked statistically significant difference, between sleeping time and obesity in 9 year olds. The mean physical activity time appears to be increased (Table 4.3.5.1 / 4.3.5.2).

<table>
<thead>
<tr>
<th>Body Mass Index Males &amp; Females</th>
<th>Lean</th>
<th>Overweight</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active physical activity [hrs/wk]</td>
<td>$11.69 \pm 5.76$ [142]</td>
<td>$9.93 \pm 5.19$ [34]</td>
<td>$9.75 \pm 5.79$ [26]</td>
</tr>
<tr>
<td>$P = 0.11 \text{ ns}$</td>
<td>$P = 0.12 \text{ ns}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive activity [hrs/wk]</td>
<td>$20.37 \pm 7.42$ [140]</td>
<td>$20.50 \pm 6.64$ [34]</td>
<td>$21.00 \pm 8.02$ [26]</td>
</tr>
<tr>
<td>$P = 0.93 \text{ ns}$</td>
<td>$P = 0.70 \text{ ns}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleeping time [hrs/wk]</td>
<td>$68.04 \pm 5.52$ [142]</td>
<td>$67.47 \pm 7.42$ [36]</td>
<td>$66.50 \pm 4.74$ [25]</td>
</tr>
<tr>
<td>$P = 0.61 \text{ ns}$</td>
<td>$P = 0.19 \text{ ns}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.5.1: Mean activity time at 5-years of age by BMI

**Student statistical tests compared to group with BMI = Lean**

<table>
<thead>
<tr>
<th>Body Mass Index Males &amp; Females</th>
<th>Lean</th>
<th>Overweight</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active physical activity [hrs/wk]</td>
<td>$8.34 \pm 4.93$ [93]</td>
<td>$8.56 \pm 4.74$ [40]</td>
<td>$7.46 \pm 4.66$ [42]</td>
</tr>
<tr>
<td>$P = 0.81 \text{ ns}$</td>
<td>$P = 0.33 \text{ ns}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive activity [hrs/wk]</td>
<td>$25.70 \pm 7.18$ [87]</td>
<td>$26.30 \pm 6.43$ [39]</td>
<td>$27.61 \pm 8.42$ [46]</td>
</tr>
<tr>
<td>$P = 0.66 \text{ ns}$</td>
<td>$P = 0.17 \text{ ns}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleeping time [hrs/wk]</td>
<td>$63.83 \pm 5.62$ [95]</td>
<td>$63.54 \pm 6.06$ [41]</td>
<td>$60.22 \pm 10.19$ [46]</td>
</tr>
<tr>
<td>$P = 0.79 \text{ ns}$</td>
<td>$P = 0.008 \text{ sig}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.5.2: Mean activity time at 9-years of age by BMI

**Student statistical tests compared to group with BMI = Lean**
4.3.6 Diet and Obesity Risk

Although no statistical differences were noted between diet and obesity risk in the 5 year old children (Table 4.3.6.1), certain trends could be observed. Less fresh fruit, vegetables, cheese, yoghurt, sweets, biscuits, and fast foods were consumed by the overweight-obese children; while more fruit juice, soft drinks, diet drinks, milk whole fat, milk low fat, meat, fish and chips were being consumed.
<table>
<thead>
<tr>
<th>Food</th>
<th>Lean Most times – everyday</th>
<th>%</th>
<th>Overweight/obese Most times - everyday</th>
<th>%</th>
<th>p value</th>
<th>Chi square test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh fruit</td>
<td>98</td>
<td>68.1</td>
<td>35</td>
<td>56.5</td>
<td>p = 0.16 ns</td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td>45</td>
<td>31.3</td>
<td>17</td>
<td>27.4</td>
<td>p = 0.70 ns</td>
<td></td>
</tr>
<tr>
<td>Fruit juice</td>
<td>41</td>
<td>28.5</td>
<td>23</td>
<td>37.1</td>
<td>p = 0.29 ns</td>
<td></td>
</tr>
<tr>
<td>Soft drinks</td>
<td>31</td>
<td>21.5</td>
<td>18</td>
<td>29.0</td>
<td>p = 0.33 ns</td>
<td></td>
</tr>
<tr>
<td>Diet drinks</td>
<td>15</td>
<td>10.4</td>
<td>8</td>
<td>12.9</td>
<td>p = 0.78 ns</td>
<td></td>
</tr>
<tr>
<td>Milk whole fat</td>
<td>107</td>
<td>74.3</td>
<td>47</td>
<td>75.8</td>
<td>p = 0.96 ns</td>
<td></td>
</tr>
<tr>
<td>Milk low fat</td>
<td>10</td>
<td>60.9</td>
<td>9</td>
<td>14.5</td>
<td>p = 0.15 ns</td>
<td></td>
</tr>
<tr>
<td>Milk flavoured</td>
<td>44</td>
<td>30.6</td>
<td>19</td>
<td>30.6</td>
<td>p = 0.89 ns</td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>70</td>
<td>48.6</td>
<td>25</td>
<td>40.3</td>
<td>p = 0.35 ns</td>
<td></td>
</tr>
<tr>
<td>Yoghurt</td>
<td>88</td>
<td>61.1</td>
<td>33</td>
<td>53.2</td>
<td>p = 0.37 ns</td>
<td></td>
</tr>
<tr>
<td>Meat</td>
<td>36</td>
<td>25.0</td>
<td>20</td>
<td>32.3</td>
<td>p = 0.37 ns</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>8</td>
<td>50.6</td>
<td>6</td>
<td>90.7</td>
<td>p = 0.44 ns</td>
<td></td>
</tr>
<tr>
<td>Chips</td>
<td>24</td>
<td>16.7</td>
<td>13</td>
<td>21.0</td>
<td>p = 0.59 ns</td>
<td></td>
</tr>
<tr>
<td>Sweets</td>
<td>89</td>
<td>61.8</td>
<td>29</td>
<td>46.8</td>
<td>p = 0.07 ns</td>
<td></td>
</tr>
<tr>
<td>Biscuits</td>
<td>46</td>
<td>31.9</td>
<td>18</td>
<td>29.0</td>
<td>p = 0.80 ns</td>
<td></td>
</tr>
<tr>
<td>Fast food</td>
<td>21</td>
<td>14.6</td>
<td>8</td>
<td>12.9</td>
<td>p = 0.92 ns</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.3.6.1: Diet and obesity relationships in 5 year old children

In contrast, statistically significant differences in dietary patterns were observed between lean and overweight-obese 9 year olds (Table 4.3.6.2). The overweight-obese group, were reported to consume a statistically lower proportion of fruit juice, and flavoured milk; and a higher proportion of low fat milk. Other non-statistically significant trends could be observed, suggesting that less vegetables, soft drinks, whole fat milk, yoghurt, meat, chips, sweets, biscuits, and fast foods were consumed by overweight-obese children. In contrast, more fresh fruit, diet drinks, cheese, and fish were consumed in this group.
### Table 4.3.6.2: Diet and obesity relationships in 9-year old children

<table>
<thead>
<tr>
<th>Food</th>
<th>Lean</th>
<th>Overweight/ obese</th>
<th>p value</th>
<th>Chi square test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Most times – everyday %</td>
<td>Most times – everyday %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh fruit</td>
<td>59</td>
<td>61.5</td>
<td>57</td>
<td>64.8</td>
</tr>
<tr>
<td>Vegetables</td>
<td>42</td>
<td>43.8</td>
<td>37</td>
<td>42.0</td>
</tr>
<tr>
<td>Fruit juice</td>
<td>37</td>
<td>38.5</td>
<td>20</td>
<td>22.7</td>
</tr>
<tr>
<td>Soft drinks</td>
<td>33</td>
<td>34.4</td>
<td>20</td>
<td>22.7</td>
</tr>
<tr>
<td>Diet drinks</td>
<td>5</td>
<td>50.2</td>
<td>10</td>
<td>11.4</td>
</tr>
<tr>
<td>Milk whole fat</td>
<td>67</td>
<td>69.8</td>
<td>49</td>
<td>55.7</td>
</tr>
<tr>
<td>Milk low fat</td>
<td>9</td>
<td>90.4</td>
<td>24</td>
<td>27.3</td>
</tr>
<tr>
<td>Milk flavoured</td>
<td>28</td>
<td>29.2</td>
<td>13</td>
<td>14.8</td>
</tr>
<tr>
<td>Cheese</td>
<td>40</td>
<td>41.7</td>
<td>39</td>
<td>44.3</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>32</td>
<td>33.3</td>
<td>26</td>
<td>29.5</td>
</tr>
<tr>
<td>Meat</td>
<td>36</td>
<td>37.5</td>
<td>28</td>
<td>31.8</td>
</tr>
<tr>
<td>Fish</td>
<td>5</td>
<td>50.2</td>
<td>8</td>
<td>90.1</td>
</tr>
<tr>
<td>Chips</td>
<td>19</td>
<td>19.8</td>
<td>9</td>
<td>10.2</td>
</tr>
<tr>
<td>Sweets</td>
<td>50</td>
<td>52.1</td>
<td>42</td>
<td>47.7</td>
</tr>
<tr>
<td>Biscuits</td>
<td>37</td>
<td>38.5</td>
<td>22</td>
<td>25.0</td>
</tr>
<tr>
<td>Fast food</td>
<td>19</td>
<td>19.8</td>
<td>11</td>
<td>12.5</td>
</tr>
</tbody>
</table>

4.4 Conclusion

In this study, a number of significant findings can be noted when correlating childhood obesity to the various factors. Tendencies were found between a history of metabolic disease in the parents and obesity in the corresponding children. A statistically significant relationship was found between a history of a lack of breast feeding and obesity in the five year old group. Statistically significant observations between birth weight, anthropomorphic measures and physical activity could also be noted. Certain observations
were also found between physical activity and corresponding obesity in both age groups, as were statistically significant relationships between diet and childhood obesity especially in the nine year olds.
Chapter 5

DISCUSSION

5.1 Introduction

Childhood obesity and the consequences of a life-long exposure to the obese state has become a global concern, particularly in the developed world. A steady increase in body weight has been noted in the last decades in many developed countries. This observation has also been made for the Maltese population, so that the 2001-02 Health Behaviour in Schoolchildren Study (HBSC) has shown that the overweight-obesity prevalence among Maltese children was 33.3% (overweight 25.4%; obese 7.9%) (Janssen et al. 2005). Childhood obesity has been shown to confer long term effects on mortality and morbidity. Therefore the prevention of obesity in children and adolescence has been argued as being a public health priority to combat the adult obesity epidemic (Wang and Lobstein 2006). Children who have a predisposition to develop obesity have been shown to have pre-existing “nature” or “nurture” contributors. The identification of these factors and their relative importance in a particular population, would serve to identify children at risk, and hence promote targeted life-style interventions early on in life, to prevent the persistence of the metabolic state into adult life with its attendant morbidities.
5.2 Epidemiology

The prevalence of overweight and obesity in Maltese children has been increasing progressively. In a study conducted in 1996, about 26% (boys 25.6%; girls 26.6%) of 3 year old Maltese children were reported to have a body weight greater than the 75th percentile (Buttigieg 1997). A decade later in 2007, the overweight/obesity rates for 4 to 5 year olds was reported to be to be 27.8% in boys and 25.8% in girls (Grech and Farrugia Sant'Angelo 2009). The present study suggests that prevalence rates of overweight/obesity in 5 to 6 year old Maltese children have risen to 28.8% in males, and to 32.7% in females. An even more alarming increase has been noted in the older children. In 1992, the overweight/obesity prevalence in Maltese 10 year old children was reported to be 32.7% in boys and 38.5% in girls (Lobstein et al. 2004). The present rates in 9 year old Maltese children have been shown by the present study to have reached values of 48.9% in boys and 45.1% in girls. The apparent increase in the prevalence rates in 9 year old Maltese children, would suggest that the overweight-obesity rates for the pubertal children aged 10-16 years reported in 2001-02, which amounted to 30.9% in boys and 20.1% in girls (Janssen I. et al. 2005), would now also be at higher levels.

In a study examining the worldwide trends in childhood overweight and obesity, Wang and Lobstein reported that by 2010, based on secular trends and the assumption that these trends will maintain a linear increase, over 46% of school-age children in the
Americas will be overweight or obese by IOTF criteria; while the overweight-obese prevalence in childhood will approximate 41% in the Eastern Mediterranean region and 38% in the European region (Wang and Lobstein 2006). The high prevalence rates for the 9 year old children in this study far exceed the rates estimated for Europe and the Eastern Mediterranean region for the year 2010. A further study conducted by Jackson-Leach and Lobstein in 2006, reported that by the year 2010, children in the European Union will exhibit a prevalence of overweight and obesity at 36.7% and an obesity rate of 8.8%. In contrast, this study showed far higher prevalence rates with 9 year old boys and girls exhibiting an overweight prevalence of 20.6% in boys and 25.3% in girls; while the obesity prevalence figures were 28.3% and 19.8% respectively. The secular trends in Malta suggest that the overweight-obesity prevalence in the Maltese Islands has increased at a far excessive rate than postulated by earlier studies. It is clear that the problem of overweight-obesity in this country has reached even more alarming levels.

5.3 Risk Factors

Obesity in childhood is associated with the presence of precedent risk factors that relate either to nature (genetic or hereditary) or nurture (early imprinting). Various such correlations in the Maltese children population have been noted in this study.
5.3.1 Genetic and Biological Factors

In the present study, when a family history defined by a history of hypertension or diabetes mellitus in either or both parents, was correlated against childhood obesity in both age groups studied, an increased tendency for a positive association was found, however without showing statistical significance. This observation confirms previous studies (Glowinska et al. 2002); (Robinson et al. 2004). Glowinska et al in 2002 reported that in a series of patients from referral clinics, approximately one third of obese children were found to have a positive family history of cardiovascular disease (CVD) (defined as CVD, myocardial infarction, stroke, or recognized CVD risk factors, including obesity, hypertension, and diabetes). Similarly Robinson et al in 2004 reported that a family history of hypertension was associated with higher child Body Mass Index (BMI).

In this study, it can be argued that since the parents of the children were still of a relatively young age group, full-blown clinically identified metabolic disease may have not yet set in. It is also possible that not all the parents interviewed in this study were properly aware of their health status and a further percentage of these actually were suffering from elements of insulin resistance and were still not aware of it. Follow-up interviews, 10-15 years later may show a higher prevalence of metabolic disorders in the parents. The study protocol could have been better designed to include formal examination and investigations
of the parents to assess for features of metabolic disease rather than rely on self-filled questionnaires.

It is well established that traits and components of metabolic syndrome tend to cluster in families. In comparison to children whose parents do not meet the criteria for the metabolic syndrome, individuals with at least one parent who meets the criteria for the syndrome have a significantly increased odds ratio for having abdominal obesity (Park et al. 2006). Whereas, the heritability of the syndrome itself has been reported to be in the range of about 25%, heritability of some of its individual components has been shown to be as high as 60% (Lin et al. 2005).

As can be seen above, children who have a family history of metabolic syndrome are predisposed to becoming obese, and due to this obesity also developing metabolic syndrome themselves. Taking into consideration the nature of the family physician relationship with the family, the family physician has an important role to play in identifying this risk factor, in the younger members of the family. A detailed family history must be compiled for all children seen. The family physician can also introduce healthy living concepts at an early stage.
5.3.2 Early Metabolic Imprinting

A number of epidemiological studies have identified that intrauterine nutrition can determine the development of metabolic syndrome in adult life – foetal origins of adult-onset disease theory. These observations have been emulated in the Maltese population (Savona Ventura et al. 2007). Early infant nutrition has also been suggested to play a role in the development of adult-onset metabolic disease.

5.3.2.1 Breastfeeding

The extent and duration of breastfeeding have been previously reported to be inversely associated with the risk of obesity in later childhood; the relationship being possibly mediated by physiologic factors in human milk as well as by the feeding and parenting patterns associated with nursing (Buttigieg 1997) (Von Kries et al. 1999). A similar association was found in this current study. In the 5 year old population studied, a significant negative relationship was found between these children and a history of breastfeeding \((p=0.04)\). Thus, breastfed children showed a lower prevalence of overweight-obesity as compared to those who were bottle-fed. This relationship was also evident in the 9 year old population, but here a statistical significance was not reached. The loss of statistical strength may be possibly attributed by the introduction of other influencing
environmental factors, such as diet and lack of physical exercise, with increasing age of the child. These factors, by 9 years of age would cancel out and modify the metabolic imprinting of breast feeding. The present study has shown that breastfed children have a reduced risk of becoming overweight-obese. This confirms previous studies reported (Buttigieg 1997); (Von Kries et al. 1999). Breastfeeding intrinsically allows a baby to set its appetite regulatory pathways, in such a way as to limit the propensity to overeat (Miller et al. 2004). The family physician must use all the opportunities that present to him during the antenatal period and in the postpartum period to encourage and support breast feeding both in its initiation and duration.

5.3.2.2 Birth Weight

The present study has shown an inter-relationship between birth weight and the risk of developing overweight-obesity in childhood. The macrosomic infant born with a birth weight of 4 000 g or more, has been shown to have higher mean anthropomorphic measurements both at 5 years and 9 years of age, when compared to the corresponding children born with a birth weight of 2 500-3 999 g. Statistical significance was only shown at 9 years of age. The low birth weight (<2 500 g) individuals showed lower mean anthropomorphic measurements at 5 years of age but higher mean values at 9 years of age. It would thus appear that from birth to 5 years, these children are still passing through their 'catch up growth period', correcting for the effects of their in utero period of limited
nutritional resources. By 9 years of age, these children have caught up and passed through their 'catch up growth period', so that their anthropomorphic parameters now lie in the overweight-obese range. During and following the 'catch up growth' the children are exposed to a practically limitless supply of calories. The present findings observed in the 9 year old population support the previously reported ‘U’ odds-risk pattern described in the thrifty phenotype hypothesis of obesity. The thrifty phenotype hypothesis postulates that poor nutrition in foetal life is detrimental to the development and functioning of β-cells and insulin-sensitive tissues, resulting in the emergence of insulin resistance or metabolic syndrome later in life (Miller et al. 2004). A similar U-shaped inter-relationship has been described in the Maltese population in relation to risk of developing gestational diabetes (Savona Ventura and Chircop 2003).

A further observation relating to birth weight inter-relationships was that the physical activity in the low birth weight 9 year old children was markedly decreased (p = 0.002), when compared to the 5 year old counterparts. It could be argued that in the older age group, because of the development of overweight-obesity resulting from the thrifty phenotype and other environmental risk factors, these children are further discouraged from performing physical exercise. This sets in a vicious cycle of increasing body weight, leading to decreased physical activity, and as result, promoting a further tendency to increasing the degree of obesity.
Prevention and early identification is the key to decreasing the prevalence of obesity in childhood. The family doctor must closely monitor all children born in the low and high birth weight groups, because as has been shown in this study, these children are predisposed to becoming obese.

5.3.3 Socio-Economic Status

A positive correlation between a lower socio-economic status (SES) and childhood obesity in both age groups could be seen, but this was not found to be statistically significant. Both the number of parents gainfully employed and the educational status levels of the parents could be contributing to the level of obesity in their children. These observations confirm a previous reported study commissioned by the British Department of Health in 2005 “Obesity among children under 11”. In this report, it was observed that childhood obesity was lowest among managerial or professional households (12.4%), and highest among semi-routine and routine households (17.1%) (Jotangia et al. 2005).

Individuals of any age rarely, if ever, act or respond independently of their social and physical environments. Children and adolescents are influenced by home, school and after-school environments, as well as by family and peer dynamics (Krebs et al. 2007). Lower SES may be related to increased risks of obesity because of less healthy eating patterns, its relationship to decreased physical activity, and also poor home environment
(Sobal and Stunkard 1989). Children and adolescents of lower SES have been reported to be less likely to eat fruits and vegetables, and to have a higher intake of total and saturated fat. Absence of family meals is associated with lower fruit and vegetable consumption, as well as consumption of more fried food and carbonated beverages (Kennedy and Powell 1997).

The present study has shown that the obesity rate in 9 year old boys was 1.4-times higher than in girls. This observation, has been made by other researchers and it has been suggested that parents may be less likely to encourage sons to lose weight, possibly because the overweight-obese large pubertal male image is conceived as the male body shape (Ricciardelli and McCabe 2001). Parents also appear to be strong influences on physical activity in childhood, and there is evidence of gender differences; for example, stronger relationship with parental activity for girls (Norton et al. 2003).

5.3.4 Physical Activity

The rapid increase in the prevalence of obesity worldwide and locally cannot be attributed to changes in the genetic makeup because the gene pool has not changed in the past decade. Therefore, the main concerns of researchers should be to identify the changes in activity and diet that occurred simultaneously with changes in prevalence (Burniat et al. 2006). This study has shown that when all parameters relating to physical activity were
associated, the overweight-obese children in both age groups reported less mean active physical activity than their leaner counterparts. The differences were however not statistically significant.

The degree of a person’s physical activity markedly affects total energy expenditure, and thus energy balance. Low physical activity levels are associated with obesity in children and adolescents, and may be both the cause and consequence of increased body weight (Klesges et al. 1995). The findings in this study confirm previous studies reported by (Jotangia et al. 2005); (Janssen et al. 2005). Jotangia et al (2005) reported that although no statistical differences were observed, there was a tendency for obesity rates to rise as children’s level of physical activity fell: 14.8% of those who were highly active were obese compared with 17.4% of those classified as sedentary. Janssen et al (2005) evaluated the relationships between overweight and obesity in school-aged children and physical activity in 34 primarily European countries, including Malta. The study showed that within most countries lower physical activity participation and higher television viewing, were associated with a greater likelihood of being overweight, implying that physical inactivity is an important determinant of overweight in children throughout the industrialised world.

As can be seen in this current study, sleeping time was found to be less in both the overweight and obese groups with a markedly statistical difference between sleeping time and obesity in the 9 year olds (p=0.008). It can be argued, that the overweight and obese
children were spending more time performing passive activities instead of sleeping. It could further be argued, that once these children were not spending as much time performing active physical activity, as compared to their leaner counterparts - they required less sleeping time. It was also noted, that the mean passive activity time appears to be increased in the overweight and obese groups.

The past few decades have brought marked lifestyle changes throughout the world which have resulted in a decrease in physical activity. Children use automobiles rather than walking to get from place to place, even if distances are comparatively short. The amount of time that children spend playing outside has diminished over the past few decades. In Maltese schools, less break time is given to school children, in exchange for more lesson time. Fear of children playing outside without adult supervision has led many parents to admonish their children to stay inside after school. Children are thus spending more time watching television and playing on the computer than exercising (Saelens et al. 2002).

More physical activity is linked with prevention of obesity. It cannot be emphasised enough that this needs to be a family affair. Use of the car needs to be questioned by parents at all times. Every opportunity to walk instead of drive needs to be pursued. Here the family doctor, more than any other health care worker is the most suitable to modifying this life style change due to his constant and repeated family intervention.
5.3.5 Diet and Obesity Risk

Over the last decades, food has become more affordable to larger numbers of people, as the price of food has decreased substantially relative to income. In addition, the concept of ‘food’ has changed from a means of nourishment to a marker of lifestyle and a source of pleasure. The increase in food intake is unlikely to be offset by an increase in physical activity (Dehghan et al. 2005). Styne in 2005, reports that it takes between 1-2 hours of extremely vigorous activity to counteract a single large-sized (i.e. ≥785 kcal) children’s meal, at a fast food restaurant. Frequent consumption of such a diet can hardly be counteracted by the average child or adult. Many complex dietary factors are associated with obesity; and age, gender, and genetic predisposition are likely to influence their effects (Krebs et al. 2007).

The overweight-obese 5 year old children in this study showed a tendency to consume less fresh fruit and vegetables. They also consumed a smaller amount of ‘energy dense’ foods, namely cheese, yogurt, sweets, biscuits and fast foods. On the other hand, these children consumed more fruit juice, soft drinks, diet drinks, whole fat milk, low fat milk, meat, fish and chips.
Fruits and vegetables are high in fibre and water content, and they may play a role in promoting satiety and decreasing total energy intake, by displacing energy-dense foods. This study confirms two studies that reported that fruit consumption was inversely associated with weight status in children (Nicklas et al. 2003); (Lin and Morrison 2002), but a relationship with vegetable intake was not apparent. This study also confirms the findings in the Bogalusa Heart Study, which examined the energy intake among 10 year old children from 1973 to 1994. The Bogalusa Heart Study showed, that children who did not consume sweetened beverages, did not have an increased energy intake. However, energy intake did increase among children who consumed sweetened beverages (Troiano and Flegal 1998). Recently, 100% fruit juice has received much attention as the possible culprit in the prevalence of obesity among young children. In 2001, the Committee on Nutrition of the American Academy of Paediatrics concluded that 100% fruit juice, had no beneficial effect over whole fruit for infants >6 months of age and children (American Academy of Pediatrics. 2001). In this study, the overweight-obese 5 year olds showed a tendency to consume more fruit juice. This confirms two previous separate studies. Dennison et al, in 1997 showed that consumption of 100% fruit juice and apple juice, was only associated positively with BMI in samples of children aged 2 to 5 years. Similarly, Tanasescu et al, in 2000 found that fruit juice and possibly fruit drinks were associated with the development of obesity in 29 Puerto Rican children aged 7 to 10 years.

The present study also found that the overweight-obese five year old children were more likely to consume potato chips. A similar positive association between intake of
potatoes and weight gain in adults was made in a study by Lin and Morrison in 2002. Potatoes are carbohydrate rich tubers, which typically are consumed after cooking in fat or oil, c.f. fried potato chips.

The 5 year old overweight-obese children in this study were reported as consuming fewer sweets. While this was a surprising observation, this finding confirms a previous finding by Janssen et al in 2005, where in 31 out of 34 countries examined (91%), there was a significant negative relationship between the intake of sweets and the BMI classification, such that with increasing sweet intake there appeared to be a decreased likelihood of overweight. The authors of the latter study propose that this observation may be due to a deliberate restriction in sweet intake by overweight children, or their parents, in an attempt to control weight gain. Similar reasoning may also explain the observed negative relationship between other energy dense food items consumption and the BMI classification in the 5 year olds in this study.

In this study, the 9 year old children show some interesting statistically significant differences when correlating diet to their BMI classification. The overweight-obese group were reported to consume a statistically lower proportion of fruit juice, flavoured milk, and a higher proportion of low fat milk. Other energy dense food items were consumed at a lower proportion by this group, and although statistically significance was not reached, certain tendencies could be noted. It can also be noted that the overweight-obese 9 year olds, consumed more of the food items which were not energy dense. In this older age
group, similarly to what was previously explained in the overweight-obese 5 year olds, these children could be deliberately restricting the consumption of energy dense food, in order to control weight. It could be argued that despite their efforts to control their weight, at the age of nine years the metabolic syndrome has already set in, making these efforts more difficult, especially when associated with their tendency not to perform adequate physical exercise.

It must also be mentioned that caution must be taken on interpretation of these results, because even although statistical significance was reached in some observations, the details of the children’s consumption was collected through a questionnaire, which was completed by proxy through the parents/carers. Recent evidence has suggested that people who are obese may misreport food consumption when asked (Fisher et al. 2000). As parents of obese children are more likely to be either overweight or obese themselves (Buttigieg 1997), it may be that energy rich food consumption is under reported, and consumption of food such as fresh fruit and diet drinks over reported. Collaboration between family physicians, families, and communities, including schools is essential to advocate the need for children to reduce energy dense food.
5.4 Limitations

The first limitation to this study is that this is a cross-sectional study and it is difficult to make casual inferences. A cross-sectional study is only a snapshot in which the situation may provide differing results if another time frame had been chosen. Furthermore, the sample size may also have been a limiting factor. Although the sample size of children of both age groups used in this study was calculated to be representative of the corresponding population in Malta, the population size of 431 children involved in this study is small. Due to this small population size, certain associations between overweight-obesity and other variables may have been missed and statistical significance not reached.

The study samples did not include children from the neighbouring island of Gozo. This may have caused some important associations to be missed when correlations between childhood obesity and the other variables were performed, although the socio-economic and cultural characteristics between the two islands are similar, thus creating a similar ‘obesogenic’ environment.

The response rate of the questionnaires was also low in a number of schools - being lowest at 44.1% among the 5 year olds in the Mellieha primary school. The parental willingness to participate in the study and complete the questionnaire may theoretically be influenced by the parents’ attitudes towards their child’s body weight. There may thus have
been a possibility that a number of parents of overweight-obese children, were reluctant and did not fill in the questionnaires, or if they did their reporting may have been skewed. Due to this, important data could have been missed. Another reason for a low response rate in certain schools could have been due to the length of the questionnaire that included a total of 33 questions. The questionnaire used was that designed by the WHO European Child Obesity Surveillance Initiative, even though this initiative allows for the omission of non-core questions to reduce questionnaire length. This surveillance programme is undertaken periodically in European countries. Also, this questionnaire required that the dietary patterns and physical activity variables are reported by the parents, and thus information was only obtained on the frequency and not the total volume of these variables.

Another limitation to this study could be that once the parents of the children included in this study were of a relatively young age, components of the metabolic syndrome may have not yet been apparent. An assessment of the parents involved in this study, namely of their blood pressure and lipid profile may have made associations between obesity in childhood and metabolic syndrome in the parents more apparent.

The data observations need to be treated with caution. Although valuable as a tool for comparing populations, the use of a single set of BMI cut-off points (IOTF) to subdivide the study populations may not be ideal. The standardised IOTF cut-offs were developed using data from six populations (UK, USA, the Netherlands, Brazil, Singapore and Hong Kong) amalgamated to provide the reference population. This range of
populations, may not properly reflect the trends and health risk within other specific countries (Vignerová J. et al. 2001). The identified BMI cut-off points may not be a true indicator of risk to ill-health, since an overweight child in one country in Europe may not be equally at risk of metabolic-related disease as a similarly overweight child of a different ethnicity, due to genetic and environmental differences.

One difficulty with the area of research concerning interpretation of waist circumference is that, despite increasing interest in the measurement of regional fat distribution, commonly accepted cut-offs for classifying subjects with high central adiposity do not yet exist (Taylor et al. 2000). In this study, an arbitrary cut-off was chosen to define high trunk mass (≥ 75th percentile). Blood samples or blood pressure measurements were not collected in this study, thus, it cannot be said whether these cut-offs were associated with increased metabolic risk. Blood pressure measurements of the children taking part in this study were commenced but had to be stopped because of erratic readings. This may have been due to that the children did not have a period of rest prior to the taking of measurements or that a number of children may have been anxious. In future studies on childhood obesity it would be advisable for the measurement of blood pressure to be taken. This would best done in a clinic setting were it would be ensured that the children have passed through a period of rest prior to measurement.
5.5 Conclusion

Grech and Farrugia Sant' Angelo in 2009 concluded that on the basis of obesity costings made for other countries, the treatment of the complications of obesity in Malta will reach €70 000 000 by the time that today’s children will reach adulthood. Childhood obesity has major short and long-term consequences on both the individual’s health and well-being and on the costs to health care service provision. The Public Health Authorities must direct significant public funding to effectively address the problem, while a comprehensive national obesity strategy must be quickly drawn up and implemented. Public education campaigns need to be instituted so that parents are better informed about the problem, and the possible contributions they can make to improve the health of their children (Koletzko et al. 2002). Public and private funding agencies should also give a high priority, to promoting further research on the aetiology and prevention of obesity, in local children and adolescents.

Family doctor practitioners and other health care workers dealing with children need to become better attuned to the problem of childhood obesity. They need to further their training, to enhance their awareness towards the problem of overweight and obesity in childhood. Their practice should include measures whereby children at risk of developing obesity are identified early, in order that timely intervention and advice to parents can be
given. The family doctor practitioner is in an ideal situation to educate parents about the problems of childhood obesity and its management.
Chapter 6

Recommendations

Child obesity is becoming a public health issue rather than a health service issue. Blaming individuals for their excessive body weight should no longer be acceptable. The media has brought to the front, several public health issues, e.g. the recent pandemic of the H1N1 influenza virus affliction, however, due attention must be given to the more urgent and deadly issue of the epidemic of childhood obesity. The prevalence of childhood obesity is rapidly growing worldwide, and as has been demonstrated in this study, the Maltese community has reached alarming rates. The causes of the rapidly growing epidemic are societal and will require substantial changes of strategy. Almost all public health researchers and clinicians agree that prevention could be the key strategy for controlling the current epidemic of obesity (Müller et al. 2001). Measures will need to be taken both ‘downstream’ in the school, home and neighbourhood environment, and ‘upstream’ in term of policies for food supplies, commercial marketing and the promotion of healthier lifestyles (Jotangia et al. 2005).

In 2007 data was drawn from an Environment and Health Information System (ENHIS-2) project survey of national experts covering 25 countries in the WHO European Region in 2005-2006 (World Health Organization. 2007). This survey presented a snapshot picture of the implementation of a set of policies aimed at reducing and preventing
childhood excess body weight and obesity. They were analysed taking into account the environmental and policy context. Although this document shows that Malta was heading the list of 25 countries implementing 12 policies at reducing excess body weight, in practice there is still much to be done at a national level. National surveys and statistics highlight the fact. At present, Malta does not have a national obesity strategy. Work is presently being carried out to furnish a national document which should be presented to Cabinet by the end of 2010.

Prevention of childhood obesity should be mainly divided into two main areas, namely proper health supervision, and advocacy (American Academy of Pediatrics. 2003). Both these strategies would be most suited to the family physician considering his role in the community.
### Health supervision

- Identify and track children at risk by virtue of their family history, birth weight and socio-economic factors.
- Calculate and plot BMI once a year in all children and adolescents.
- Encourage and support breast feeding.
- Encourage parents and caregivers to promote healthy eating patterns.
- Routinely promote physical activity, including play at home, in the school, in child care settings, and throughout the community.
- Recommend limitation of television time to a maximum of 2 hours per day.
- Screening and monitoring for possible metabolic complications in the overweight-obese children such as hypertension, dyslipidemia, hyperinsulinemia, impaired glucose tolerance, and symptoms of obstructive sleep apnoea syndrome.
- Formal training of family physicians and other health care workers in prevention and management of childhood obesity.
- Children with components of the metabolic syndrome may benefit from referral to a paediatric endocrinologist who has experience with the management of obesity, hypertension, dyslipidemia or insulin resistance.
- Further local research to investigate any possible associations between childhood obesity and parental metabolic syndrome, especially in an older parental age group.
- Further local research investigating the prevalence of metabolic syndrome in overweight-obese children, namely hypertension, dyslipidemia and impaired glucose tolerance.

### Advocacy

- Help parents, teachers and others who influence youth to discuss health habits, as part of their efforts to control overweight and obesity.
- Encourage legislation to be passed requiring a minimum of 30 minutes daily of physical exercise in both primary and secondary schools. At present in the local secondary school level, physical exercise classes are only performed for 30 minutes per week.
- Encourage enforcement of legislation requiring labelling of foods with nutritional information such as ingredients and the corresponding energy intake.
- Encourage the local market concerned with consumable goods to adopt a system of signposting of food items. In the “stoplight diet” developed by Epstein and Squires in 1998, children and families may choose food from three categories that correspond to the three colours on a traffic light: ‘green’ foods may be eaten anytime; ‘yellow’ foods are to be consumed less often and ‘red’ foods should be avoided.
- Encourage local authorities that are responsible for health care and health financing to provide coverage for effective prevention and treatment strategies.
- Enhancing awareness and competence among parents, teachers, and the general public.

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Table 6.1: Recommendations to counteract childhood obesity
It is timely that guidelines and recommendations are officially published locally for all family doctors to follow in combating this national epidemic.

6.1 The family doctors role

The effective prevention and management of childhood obesity must be a family focused approach. The issue of obesity and its management needs to be raised sensitively. Obese children or adolescents are usually very concerned about their problem but may not specifically ask for help. This is often confounded by the fact that most obese children have obese parents. Some people will welcome the opportunity for immediate intervention, whereas in others the family doctor may simply be laying the foundation for later acceptance of therapy (Baur 2003).

All obese children should have a full history and physical examination performed. Their height and weight should be measured and Body Mass Index (BMI) calculated. Considering that BMI varies normally throughout childhood, this should be plotted on BMI-for-age charts as those used in this study (Cole et al. 2000). Waist circumference can be used as a proxy for abdominal obesity. Identification of risk factors of childhood obesity is paramount, while complications should be sought on physical examination. Proper recording of all data must be kept for monitoring of the child’s condition. Initial risk factors for eventual childhood obesity can be identified at birth - infant birth weight and maternal
antenatal conditions – and the child flagged as being high risk on its medical record book. This would immediately alert the attending physician who will ensure BMI and waist circumference measurement follow up, and thus give timely suitable advice to the parents about lifestyle changes which could influence the development of childhood obesity.

Families influence food and activity habits, and thus effective therapy of obesity must be family focused (Baur 2003). Parents and adult caregivers play an important role in the development of proper eating habits by young children. The parents' food preferences, the quantities and variety of foods in the home, the parents’ eating behaviour, and the parents physical activity patterns work in concert to establish an emotional environment, in which obesity may or may not be discouraged (Dietz 1993). A study has shown that long term maintenance of weight loss can be achieved when the intervention is family based (Golan et al. 1998).

Involvement of the entire family, in the prevention and control of childhood obesity is usually vital. The family doctor must promote healthy life styles in the family unit. The following are some healthy life style issues the family doctor can advocate:

- Parents should not fetch and carry for their children – small chores provide an opportunity for physical activity
- Think of activity as fun, rather than as a ‘doctor prescribed therapy’
• A maximum of two hours of television or computer use per day

• The family car should be avoided for short distances especially if the school is in the same village the child resides in

• Using low fat dairy products

• Increasing amount of fruit and vegetables consumed

• Making time to eat breakfast

• Eating meals together as a family

• Drinking water with meals
References


Appendix A
Dear parents/carers,

I am currently conducting a study regarding obesity in Maltese children aged 5 and 9 years. As many of you are aware the incidence of obesity in the Maltese islands as well as worldwide is increasing. The aim of this study is to investigate the obesity status of the Maltese children and as a result making suggestions on how this obesity issue can be tackled.

In this study a total of 400 participants will be recruited. The parents/carers of the participants will be gently asked to fill in this questionnaire and the height, weight, waist circumference and blood pressure of the children participating will be recorded and used in this study.

The information you provide is totally confidential and will not be disclosed to a third party. It will be made anonymous and will only be used for research and monitoring purposes. All personal details will be removed from the questionnaire and only a code will be used to connect the names and the data without identifying you.

Your participation is voluntary and at the same time the study will be of great benefit to the children participating. Obesity leads to serious complications in both children and adults and through this study the obesity awareness will be made more evident. Hopefully this study would act as a stepping stone to future much needed action from all spheres in fighting against this obesity epidemic.

Should you require further information, do not hesitate to contact me on my e-mail: christopher_scerri@hotmail.com.

Yours truly,

Dr Christopher Scerri

I give my consent to my daughter/son ___________________________ attending ___________________________ to participate in the study regarding the prevalence of obesity in children.

Signature: ___________________________ Date: ___________________________
Appendix B
The prevalence of obesity in Maltese children aged 5 and 9 years – Dr Christopher Scerri

Gheżież ġenituri/carers,


F’dan l-istudju ha jiehdu sehem 400 participant. Il-ġenituri/carers huma mitluba li jimlew il-formula li hawn mehmuża biex flimkien mat-tul, il-piż, ic-cirkumferenza tal-qghad u il-pressjoni tat-tfal ha jigu miktuba u użati ghal dan l-istudju.

L-informazzjoni li ha tkun miġbura ha tinżamm kunfidenzjali u mhux ha tkun mghoddija lil hadd. L-informazzjoni ha tibqa anonima u ha tintuża biss ghal l-istudju. Id-dettalji personali ha jitnhewwe u minfolk ha jintuża kodici.

Il-participazzjoni hija volontarja u fl-istess hin it-tfal li jiehdu sehem ha jibbenifikaw. L-obesita tista twassal ghal kumplikazzjonijiet serji kemm fit-tfal kif ukoll fl-adulti u dan l-istudju ha jghin biex jaghmel lis-socjeta tikt konxja.

Jekk tkunu tixtiequ iktar informazzjoni ikkuntatjawni fuq: christopher_scerri@hotmail.com.

Dejjem taghkhom,

Dr Christopher Scerri

________________________________________

Jiena naghti il-kunsens tieghi lit-tifel/tifla ___________________________________ li tattendi l-iskola __________________ biex tippartecipa f’dan l-istudju rigward l-obesita fit-tfal.

Firma: ___________________ Data: ___________________
Appendix C
European Childhood Growth Questionnaire

Form code FAMILY

Country code □□□

GENERAL IDENTIFICATION CHILD

(1) What is your child’s name?

First name: ..................................  Surname: ..................................

(2) What is the date of the birth of your child?  Day / Month / Year

□□/□□/□□

(3) What is the sex of your child?

□ Boy

□ Girl

(4) What was the approximate birth weight of your child (in grams)?

□□□□ grams

(5) Was your child born at full term (in general after 37 weeks of pregnancy)?

□ Yes

□ No

□ Don’t know

(6) What is your postal code?  .........................

GENERAL IDENTIFICATION SCHOOL

(7) What is the name of your child’s school?  ..........................

(8) What is the location/address of your child’s school?  ..........................

With kind permission of WHO
(9) In which class/grade level is your child now? □ □

CHILD LIFESTYLE CHARACTERISTICS

The next question asks about some lifestyle characteristics of your child.

(10) How does your child usually get to and from school? Please tick one box for “Going to school” and one box for “Coming from school”.

<table>
<thead>
<tr>
<th>Going to school</th>
<th>Coming from school</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ S/he usually takes the school bus</td>
<td>□ S/he usually takes the school bus</td>
</tr>
<tr>
<td>□ S/he usually goes by public transport</td>
<td>□ S/he usually goes by public transport</td>
</tr>
<tr>
<td>□ S/he is usually brought by car</td>
<td>□ S/he is usually brought by car</td>
</tr>
<tr>
<td>□ S/he usually rides a bicycle</td>
<td>□ S/he usually rides a bicycle</td>
</tr>
<tr>
<td>□ Other (please specify):</td>
<td>□ Other (please specify):</td>
</tr>
</tbody>
</table>

(11) In your opinion, are the routes to and from school safe for your child to walk or ride a bicycle?

□ Yes
□ No

(12) How far is your child’s school from your home?

□ Less than 1 kilometre
□ 1-2 kilometres
□ 3-4 kilometres
□ 5-6 kilometres
□ More than 6 kilometres
European Childhood Growth Questionnaire

(13) Is your child a member of one or more sport or dancing clubs (e.g. football, soccer, running, hockey, swimming, tennis, basketball, gymnastics, ballet, fitness, ballroom dancing etc...)?

☐ Yes please continue with the next question
☐ No please continue with question 15

(14) Over a typical or usual week, on how many days is your child going to this/these sport or dancing club(s)?

☐ 0 day a week ☐ 4 days a week
☐ 1 day a week ☐ 5 days a week
☐ 2 days a week ☐ 6 days a week
☐ 3 days a week ☐ 7 days a week

(15) What is your child’s usual amount of sleep each day? _________ hours and ______ minutes (combining night-time sleep and naps)

(16) In his/her free time, about how many hours per day is your child usually playing outside, at home or somewhere else? Please tick one box for weekdays and one box for weekend.

<table>
<thead>
<tr>
<th>Weekdays</th>
<th>Weekend</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Never at all</td>
<td>☐ Never at all</td>
</tr>
<tr>
<td>☐ Less than 1 hour per day</td>
<td>☐ Less than 1 hour per day</td>
</tr>
<tr>
<td>☐ About 1 hour a day</td>
<td>☐ About 1 hour a day</td>
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<tr>
<td>☐ About 2 hours per day</td>
<td>☐ About 2 hours per day</td>
</tr>
<tr>
<td>☐ About 3 or more hours per day</td>
<td>☐ About 3 or more hours per day</td>
</tr>
</tbody>
</table>

(17) In his/her free time, about how many hours per day is your child usually spend doing homework or reading a book, at home or somewhere else? Please tick one box for weekdays and one box for weekend.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>☐ Never at all</td>
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<tr>
<td>☐ About 2 hours per day</td>
<td>☐ About 2 hours per day</td>
</tr>
<tr>
<td>☐ About 3 or more hours per day</td>
<td>☐ About 3 or more hours per day</td>
</tr>
</tbody>
</table>
European Childhood Growth Questionnaire

(18)  Do you have a computer at home?

☐ Yes
☐ No

(19)  In his/her free time, about how many hours per day does your child usually spend using a computer for playing games (other than homework), at home or somewhere else? Please tick one box for weekdays and one box for weekend.

Weekdays  Weekend
☐ Never at all
☐ Less than 1 hour per day  ☐ Never at all
☐ About 1 hour a day  ☐ Less than 1 hour per day
☐ About 2 hours per day  ☐ About 1 hour a day
☐ About 3 or more hours per day  ☐ About 2 hours per day

(20)  In his/her free time, about how many hours per day does your child usually spend watching television (including videos), at home or somewhere else? Please tick one box for weekdays and one box for weekend.

Weekdays  Weekend
☐ Never at all
☐ Less than 1 hour per day  ☐ Never at all
☐ About 1 hour a day  ☐ Less than 1 hour per day
☐ About 2 hours per day  ☐ About 1 hour a day
☐ About 3 or more hours per day  ☐ About 2 hours per day

(21)  Over a typical or usual week, how often does your child have breakfast?

Every day  Most days  Some days  Never
(4-6 days)  (1-3 days)
☐ ☐ ☐

(22)  Was your child ever breastfed?

☐ Yes  please continue with the next question
☐ No  please continue with question 24
European Childhood Growth Questionnaire

(23) In his/her first year of life, for how long was your child breastfed?

- [ ] Less than a month
- [ ] About 1 month
- [ ] About 2 months
- [ ] About 3 months
- [ ] About 4 months
- [ ] About 5 months
- [ ] About 6 months
- [ ] More than 6 months

(24) Over a typical or usual week, how often does your child eat or drink the following kinds of foods or beverages? Please tick one box for each line

<table>
<thead>
<tr>
<th>Food Type</th>
<th>Every day</th>
<th>Most days (4-6 days)</th>
<th>Some days (1-3 days)</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh fruit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables (excluding potatoes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% fruit juice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft drinks containing sugar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet or “light” soft drinks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole fat milk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low fat skimmed milk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flavoured milk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yoghurt, milk pudding, cream cheese/quark or other dairy products</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foods like potato chips, corn chips, popcorn or peanuts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foods like candy bar or chocolate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foods like biscuits, cake, doughnuts or pie</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With kind permission of WHO
European Childhood Growth Questionnaire

Foods like pizza, French fries, fried potatoes, hamburger, sausage or meat pies

FAMILY HEALTH CHARACTERISTICS
The next questions ask about some health characteristics of yourself and your family.

(25) During the past 12 months have you or anyone else in your household been told by a doctor or other health worker that one of you has high blood pressure (hypertension)?

☐ Yes
☐ No
☐ Don’t know

(26) During the past 12 months have you or anyone else in your household been told by a doctor or other health worker that one of you has diabetes?

☐ Yes
☐ No
☐ Don’t know

(27) During the past 12 months have you or anyone else in your household been told by a doctor or other health worker that one of you has high cholesterol level?

☐ Yes
☐ No
☐ Don’t know
European Childhood Growth Questionnaire

FAMILY GENERAL CHARACTERISTICS

The last set of questions asks about some general characteristics of yourself and your family.

(28) How many people aged 18 years or older, including yourself, live in your household? 

(29) How many people younger than 18 years live in your household? 

(30) What is the highest level of education you and/or your partner/spouse have completed? Please select one answer only for each of you.

<table>
<thead>
<tr>
<th>Mother</th>
<th>Father</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school</td>
<td>Primary school</td>
</tr>
<tr>
<td>Secondary school</td>
<td>Secondary school</td>
</tr>
<tr>
<td>Undergraduate/Bachelor degree</td>
<td>Undergraduate/Bachelor degree</td>
</tr>
<tr>
<td>Masters degree or higher</td>
<td>Masters degree or higher</td>
</tr>
</tbody>
</table>

(31) Which of the following best describes your’s and/or your partner’s/spouse’s main work over the last 12 months? Please select one answer only for each of you.

<table>
<thead>
<tr>
<th>Mother</th>
<th>Father</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government employed</td>
<td>Government employed</td>
</tr>
<tr>
<td>Non-government employed</td>
<td>Non-government employed</td>
</tr>
<tr>
<td>Self-employed</td>
<td>Self-employed</td>
</tr>
<tr>
<td>Student</td>
<td>Student</td>
</tr>
<tr>
<td>Homemaker</td>
<td>Homemaker</td>
</tr>
<tr>
<td>Unemployed, able to work</td>
<td>Unemployed, able to work</td>
</tr>
<tr>
<td>Unemployed, not able to work</td>
<td>Unemployed, not able to work</td>
</tr>
<tr>
<td>Retired</td>
<td>Retired</td>
</tr>
</tbody>
</table>

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European Childhood Growth Questionnaire

(32) In what type of housing are you currently living?

☐ House/bungalow detached
☐ House-semi-detached/terraced
☐ Apartment
☐ Shared house
☐ Shared apartment
☐ Other (please specify) ..............................................................................

(33) Is this accommodation .....?

☐ Owned by you?
☐ Rented by you?
☐ Other (please specify) ..............................................................................

Date of completion of this form Day / Month / Year

Signature ...........................................................................................................
Appendix D
European Childhood Growth Questionnaire

Kodici tal-formola FAMILJA

Kodici postali □ □ □

IDENTIFIKAZZJONI ĠENERALI TAT-TIFEL/TIFLA

(1) X'jismu/jisimha it-tifel/tifla?

Isem: ........................................ Kunjom: ........................................

(2) Meta twieded/twieldet? Gurnata / Xahar / Sena

□ □ □

(3) Tifel jew tifla?

□ Tifel

□ Tifla

(4) Kemm kien/kienet j/tizen meta twieded/twieldet?

□ □ □ grammi

(5) Πadt it-tqala kollha (minn 37 gimgha l’fuq)?

□ Iva

□ Le

□ Ma nafx

(6) X’inhu l-kodici postali tieghek? ........................................

IDENTIFIKAZZJONI ĠENERALI TA’ L-ISKOLA

(7) X’jisimha l-iskola tat-tifel/tifla tieghek? .............................................

(8) Fejn qieghda l-iskola? .............................................

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(9) F’liema sena gieghed/queda it-tifel/tifla? □ □

MOD TAL-HAJJA TAT-TIFEL/TIFLA

Il-mistoqsijet li ġejjin huma dwar il-hajja ta’ kuljum tat-tifel/tifla


Lejn l-iskola      Mill-iskola

□ Vann/pražvit ta’ l-iskola     □ Vann/pražvit ta’ l-iskola
□ Karozza tal-linja         □ Karozza tal-linja
□ Karozza                   □ Karozza
□ Rota                      □ Rota
□ Mod iehor (għid kif):       □ Mod iehor (għid kif):

(11) Fl-opinjoni tieghek, hemm periklu jekk it-tifel/tifla jmur/tmur l-iskola bil-mixi jew bir-rota?

□ Iva
□ Le

(12) Kemm hi l-boghod l-iskola mid-dar?

□ Inqas minn 1 kilometru
□ 1-2 kilometri
□ 3-4 kilometri
□ 5-6 kilometri
□ Iktar minn 6 kilometri
European Childhood Growth Questionnaire

(13) *It-tifel/tifla tieghek membru f'xi ghaqda sportiva jew skola taż-żfin (eż. futball, giri, ghawm, tennis, basketball, gymnastics, ballet, etc...)?*

☐ Iva jekk jogħġbok kompli bil-mistoqsija li jmiss
☐ Le jekk jogħġbok mur ghal mistoqsija 15

(14) *Matul il-gimgha kemm il-darba it-tifel/tifla jattendi/tattendi l-ghaqda sportive jew skola ta' żfin?*

☐ 0 granet f'gimgha
☐ 1 f'gimgha
☐ 2 f'gimgha
☐ 3 darbiet f'gimgha
☐ 4 darbiet f'gimgha
☐ 5 darbiet f'gimgha
☐ 6 darbiet f'gimgha
☐ 7 darbiet f'gimgha

(15) *Kemm il-siegha jorqod/horqod it-tifel/tifla tieghek f'gurnata? _________ siegha u ______ minuti (irqad ta' matul il-lejl u ta' matul il-ġurnata f'daqqa)*

(16) *Matul il-hin liberu, kemm 'il-siegha jqatta' t-tifel/tifla jilghab/tilghab barra id-dar jew x'imkien iehor? Jekk jogħġbok immarka kaxxa ghal matul il-gimgha u kaxxa ghas- Sibt u l-Hadd.*

Matul il-Gimgha

☐ Qatt
☐ Inqas minn siegha kuljum
☐ Xi siegha kuljum
☐ Xi saghtejn kuljum
☐ Tliet sieghat jew ġżied kuljum

Sibt u Hadd

☐ Qatt
☐ Inqas minn siegha kuljum
☐ Xi siegha kuljum
☐ Xi saghtejn kuljum
☐ Tliet sieghat jew ġżied kuljum

(17) *Matul il-hin liberu, kemm 'il-siegha jqatta' t-tifel/tifla jaqraqa/taqra ktiel jew jagħmel/tagħmel il-'homework', id-dar jew x'imkien iehor? Jekk jogħġbok immarka kaxxa ghal matul il-gimgha u kaxxa ghas- Sibt u l-Hadd.*

Matul il-Gimgha

☐ Qatt
☐ Inqas minn siegha kuljum
☐ Xi siegha kuljum
☐ Xi saghtejn kuljum
☐ Tliet sieghat jew ġżied kuljum

Sibt u Hadd

☐ Qatt
☐ Inqas minn siegha kuljum
☐ Xi siegha kuljum
☐ Xi saghtejn kuljum
☐ Tliet sieghat jew ġżied kuljum

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(18)  Ghandek kompjuter id-dar?

☐ Iva
☐ Le


<table>
<thead>
<tr>
<th>Matul il-Gimgha</th>
<th>Sibt u Hadd</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Qatt</td>
<td>☐ Qatt</td>
</tr>
<tr>
<td>☐ Inqas minn siegha kuljum</td>
<td>☐ Inqas minn siegha kuljum</td>
</tr>
<tr>
<td>☐ Xi siegha kuljum</td>
<td>☐ Xi siegha kuljum</td>
</tr>
<tr>
<td>☐ Xi saghtejn kuljum</td>
<td>☐ Xi saghtejn kuljum</td>
</tr>
<tr>
<td>☐ Tliet sieghat jew iżjed kuljum</td>
<td>☐ Tliet sieghat jew iżjed kuljum</td>
</tr>
</tbody>
</table>

(20)  Matul il-hin liberu, kemm ‘il-siegha jqatta’ t-tifel/tifla jara/tara t-TV, id-dar jew x’imkien iehor? Jekk joghgbok immarka kaxxa ghal matul il-gimgha u kaxxa ghas- Sibt u l-Hadd.

<table>
<thead>
<tr>
<th>Matul il-Gimgha</th>
<th>Sibt u Hadd</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Qatt</td>
<td>☐ Qatt</td>
</tr>
<tr>
<td>☐ Inqas minn siegha kuljum</td>
<td>☐ Inqas minn siegha kuljum</td>
</tr>
<tr>
<td>☐ Xi siegha kuljum</td>
<td>☐ Xi siegha kuljum</td>
</tr>
<tr>
<td>☐ Xi saghtejn kuljum</td>
<td>☐ Xi saghtejn kuljum</td>
</tr>
<tr>
<td>☐ Tliet sieghat jew iżjed kuljum</td>
<td>☐ Tliet sieghat jew iżjed kuljum</td>
</tr>
</tbody>
</table>

(21)  Matul il-gimgha, kemm il-darba jiekol/tiekol “breakfast” qabel l-iskola?

<table>
<thead>
<tr>
<th>Kuljum</th>
<th>Kwazi kuljum</th>
<th>Kultant</th>
<th>Qatt</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>(4-6 ijiem)</td>
<td>(1-3 ijiem)</td>
<td></td>
</tr>
</tbody>
</table>

(22)  Meta kien/et tarbiija kien/et jiehu/tiehu l-halib ta’ l-omm?

☐ Iva  jekk joghgbok kompli bil-mistoqsija li jmiss
☐ Le   jekk joghgbok mur ghal mistoqsija 24
European Childhood Growth Questionnaire

(23) Kemm dam/et jiehu/tiehu l-halib ta' l-omm fl-ewwel sena?

- [ ] Inqas minn xahar
- [ ] Madwar xahar
- [ ] Madwar xahrejn
- [ ] Madwar 3 xhur
- [ ] Madwar 4 xhur
- [ ] Madwar 5 xhur
- [ ] Madwar 6 xhur
- [ ] Iktar minn 6 xhur

(24) Matul il-gimgha, kemm il-darba it-tifel/tifla jiekol/tiekol jew jixrob/tixrob affarijiet li huma imniżżlin hawn taht? Immarka kaxxa f’kull linja

<table>
<thead>
<tr>
<th>Kuljum</th>
<th>Kwazi kuljum (4-6 ijiem)</th>
<th>Kultant (1-3 ijiem)</th>
<th>Qatt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frott frisk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haxix (minbarra patata)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% ġuš tal-frott</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Soft drinks”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Soft drinks” tad-dieta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halib</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halib xkummat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halib tal-kulur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ġobon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Yoghurt” jew prodotti maghmulin mil-halib</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laham</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ikel bhal “chips”, karawetta jew “popcorn”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helu jew cikkulata</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galletini, kejkijiet jew torti</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With kind permission of WHO
European Childhood Growth Questionnaire

Ikel bhal pizza, “burgers” u zalzett

_______________________________________________________________

INFORMAZZJONI DWAR IS-SAHHA ĠENERALI TAL-FAMILJA

Il-mistoqsijiet li ġejjin huma dwar is-sahha tal-familja tieghek.

(25) Matul din l-ahhar sena, inti jew xi membru tal-familja bdejtu tbatu minn pressjoni gholja?

☐ Iva
☐ Le
☐ Ma naʃx

(26) Matul din l-ahhar sena, inti jew xi membru tal-familja bdejtu tbatu miz-zokkor?

☐ Iva
☐ Le
☐ Ma naʃx

(27) Matul din l-ahhar sena, inti jew xi membru tal-familja bdejtu tbatu mix-xaham fid-demm?

☐ Iva
☐ Le
☐ Ma naʃx
European Childhood Growth Questionnaire

INFORMAZZJONI DWAR IL-FAMILJA

Dawn l-ahhar mistoqsijiet huma dwarek u l-familja tieghek

(28) Kemm nies li ghandhom 'l fuq minn 18 il-sena, bik b’kollox, jghixu d-dar?  □ □

(29) Kemm nies iżghar minn 18 il-sena jghixu d-dar?  □ □

(30) X’inhu l-livell ta’ l-iskola tieghek u tal-partner? Jekk joghgbok ghażel kaxxa ghall kull wiehed minnkom.

<table>
<thead>
<tr>
<th>Omm</th>
<th>Missier</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Skola primarja</td>
<td>□ Skola primarja</td>
</tr>
<tr>
<td>□ Skola sekondarja</td>
<td>□ Skola sekondarja</td>
</tr>
<tr>
<td>□ Universita’/Kullegg</td>
<td>□ Universita’/Kullegg</td>
</tr>
<tr>
<td>□ Masters degree jew Dottorat</td>
<td>□ Masters degree jew Dottorat</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Omm</th>
<th>Missier</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Impjieg mal-gvern</td>
<td>□ Impjieg mal-gvern</td>
</tr>
<tr>
<td>□ Impjieg privat</td>
<td>□ Impjieg privat</td>
</tr>
<tr>
<td>□ Self-employed</td>
<td>□ Self-employed</td>
</tr>
<tr>
<td>□ Studenta</td>
<td>□ Student</td>
</tr>
<tr>
<td>□ Mara tad-dar</td>
<td>□ Jiehu hsieb id-dar</td>
</tr>
<tr>
<td>□ Bla xoghol imma tista tahdem</td>
<td>□ Bla xoghol imma jista jahdem</td>
</tr>
<tr>
<td>□ Bla xoghol u ma tistax tahdem</td>
<td>□ Bla xoghol u ma jistax jahdem</td>
</tr>
<tr>
<td>□ Irtirata</td>
<td>□ Irtirat</td>
</tr>
</tbody>
</table>
European Childhood Growth Questionnaire

(32) *F'liema tip ta' dar toqghodu?*

- [ ] House/bungalow detached
- [ ] House-semi-detached/terraced
- [ ] Appartament
- [ ] Dar ‘shared’
- [ ] Appartament ‘shared’
- [ ] Ohra (jekk joghġbok spjega) .................................................................

(33) *Dan il-post huwa ..... *

- [ ] tieghek?
- [ ] mikri?
- [ ] Ohra (jekk joghġbok spjega) .................................................................

---

Data li mtliet din il-formula

<table>
<thead>
<tr>
<th>Ġurnata</th>
<th>Xahar</th>
<th>Sena</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Firma ...........................................................................................................
Appendix E
Ref No: 30/2008

3rd October 2008

Dr Christopher Scerri, MD
Gojjia, 106 Anglu Gatt Street
Mosta

Dear Dr Scerri

Please refer to your application submitted to the Research Ethics Committee in connection with your research entitled:

**PREVALENCE OF OBESITY IN MALTESE CHILDREN AGED 5 AND 9 YEARS**

The University Research Ethics Committee at its meeting of 12th September 2008 approved the above-mentioned Protocol.

Yours sincerely

[Signature]

Dr M Vassallo
Chairman
Research Ethics Committee