Comparison of body mass index of a national cohort of Maltese children over a 3-year interval

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Abstract

Aims: To compare body mass index (BMI) at 7 years and at 9 years of age in a national cohort of children in Malta, born in 2001, and to compare the results with an earlier study carried out in 2007 in this same cohort. Methods: BMI measurement of all children in the second year of formal school and again in the fourth year.

Results: In 2008, data was collected from a total of 3435 children (girls 48.9%, boys 51.1%) with a mean age of 6.8 years. The same procedure was carried out in 2010 on the same cohort of children. A total of 3090 children participated in the second round of data collection (girls 49.5%, boys 50.5%). Based on WHO criteria (using the 2007 WHO Child Growth Reference BMI-for-age 5-19 charts), over a quarter of Maltese children aged 7 years were found to be overweight or obese in 2008. This proportion rose to just over 40% when the same cohort was measured in 2010 at the age of 9 years. A significant prevalence of overweight and obese boys was found in Gozo for both studies. Children attending Independent (fee-paying) schools were the least overweight and obese.

Discussion: Obesity in childhood in Malta is increasing despite efforts to curb this disease. More emphasis must be made on prevention strategy in childhood as this is a key factor in reducing the burden of morbidity and mortality of childhood disease.

Keywords

Overweight, children, epidemiology, body mass index, obese, obesity/burden of disease

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Introduction

Overweight and obesity constitute a global health problem and contribute significantly to the onset of non-communicable diseases such as diabetes, hypertension, stroke, ischaemic heart disease and malignancies. Obese children tend to become obese adults and for this reason, body mass index (BMI) is routinely measured as part of the health surveillance performed by the school doctor and nurse in Malta's primary schools. This study follows a cohort of Maltese children born in 2001 who initially had height and weight taken routinely for BMI purposes in 2007,1 and who were similarly re-measured in 2008 and 2010.

Methods

Equipment and data collection

The methodology used was the same as that utilised in an earlier study carried out on Maltese children in 2007.1 All measurements were performed using portable stadiometers (SECA 214 Portable Stadiometer) and portable digital scales (BEURER PS07 Digital Weighing Scales) by school medical doctors and nurses. Height was measured following the standard method for stadiometer usage, with the head in the Frankfurt plane. Children's height and weight were taken according to previously established protocol in that children were measured dressed in light clothing. This consisted of a shirt/blouse, trousers/skirt, underwear and socks. Measurements were taken in the school clinic and the confidentiality of each student was maintained. Both data sets were collected over a seven-week period, between the first week of April and third week of May in 2008 and 2010 respectively. All measurements were taken by 8 registered nurses specialised and experienced in school nursing. These nurses work on a regional basis and have pre-assigned schools that they are responsible for. The Independent schools were distributed accordingly.

The data was inputted by two data-input clerks into a MS Excel spreadsheet. Both completed data sets were merged and cleaned by one of the authors (VFS). Children who were absent from school on the day of the examination were eliminated from the study, as were children who were repeating the scholastic year. Summary statistics, t-tests (assuming unequal variance) and one-factor analysis of variance (ANOVA) were used to compare means.

The overall results were compared with the previous (2007) study as this same cohort (born in 2001) had also been studied

Table 1: *Regional subdivision of districts in Malta*

N. Harbour	S. Harbour	West	North	S. East
Qormi	Vittoriosa	Rabat	Mellieħa	B'Bugia
B'Kara	Cospicua	Dingli	Mġarr	M'Scala
Gżira	Floriana	Attard	Mosta	Għaxaq
Ħamrun	Kalkara	Baħrija	St Paul's Bay	Gudja
Msida	Senglea	Mdina	Għargħur	Kirkop
Pembroke	Valletta	Żebbuġ	Naxxar	M'Xlokk
Pietà	Żabbar	Siġġiewi	Baħar iċ-Ċagħaq	Mqabba
St Julians	Fgura	Balzan		Qrendi
San Ġwann	Luqa	Lija		Safi
St Venera	Paola	Iklin		Żejtun
Sliema	St Lucia	Mtarfa		Żurrieq
Swieqi	Tarxien			
Ta' Xbiex	Xgħajra			

at 5-6 years of age.1 The 2007 dataset was reanalysed in order to obtain values for overweight and obesity, for both genders, using the new WHO criteria.[2]

Localities

Children were allocated by current address to one of six geographical sectors in a distribution devised by the Maltese Office of National Statistics. Towns and villages included in the relevant regions are shown in Table 1.

Schools

Education in Malta is based on the British model and education is compulsory between the ages of 5 and 16 years. Schooling in Malta is provided by: 1. State Schools, 2. Church-run schools and 3. Independent schools. Education in State schools is free of charge, Church-run schools accept voluntary donations, whereas parents who opt to send their children to Independent Schools are charged a fee. All of these schools were involved in this study. The following two schools were excluded: a) Verdala International School catering almost exclusively to the children of expatriates, b) The Miriam al-Batool school which caters almost exclusively for Muslim children who are short- or long-term residents in Malta and one or both of whose parents are not Maltese.

Table 2: *Summary statistics for BMI by gender*

	2008		2010	
	Male	Female	Male	Female
Mean	17.0	16.9	18.6	18.4
Standard error	0.1	0.1	0.1	0.1
Median	16.3	16.2	17.6	17.3
Standard deviation	2.9	2.8	3.8	3.7
Sample variance	8.2	7.6	14.4	13.8
Kurtosis	7.8	4.5	2.9	2.2
Skewness	2.2	1.7	1.5	1.4
n	1754	1680	1558	1531
Percentage	51.1	48.9	50.4	49.6

Definitions

The criteria used to identify overweight and obesity were based on the 2007 World Health Organisation (WHO) child growth reference charts of BMI-for-age for 5-19 years of age for boys and girls respectively.[2] As internationally accepted, children whose BMI was over the 85th percentile for age were considered overweight, while those whose BMI was above the 97th percentile for age were considered obese. A normal BMI for adults is from 18.5 to 24.9 kg/m^2, overweight is defined as a BMI in the range of 25 to 29.9 kg/m^2 and obese is defined as a BMI over 30 kg/m^2.

Results

General

In 2008, out of the 3734 students attending the second year of primary school, 120 were born before 2001 and 179 students were absent on the day of measurement. Therefore the surveyed population was 3435 (mean age of 6.8 years). In 2010, out of 3723 students attending the fourth year of primary school, 160 were born before 2001 and 473 were absent on the day of measurement. The surveyed population in 2010 was 3090 (mean age of 8.8 years) resulting in a 10% decrease in participation between the two years of assessment. Comparative summary statistics for BMI by gender are shown in Table 2.

The main results defining overweight and obesity are shown in table 3 (the first column of results dating to 2007 are derived

from an earlier study).[1] There is a dip in mean BMI for both overweight and obesity, for both genders, in the same cohort of children over the span of 3 years, followed by a rise to levels above the starting BMI of this study. The only exception is female obesity which simply rises steadily over the course of this study.

The same cohort of children (those born in 2001) had also been studied when they were 5-6 years old,[1] and there is an overall increase in overweight and obesity rates over the 3 years that have elapsed between the first collection of data and the last (Table 3).

By geographical area

The children's home town or village was taken as reference. In 2008, lower overall BMI's were found in the Northern district with the highest being found in Gozo (Table 4). In 2010, Gozo maintained the highest overall BMI but the Northern Harbour district had the lowest mean BMI.

If analysed by gender, then in 2008 the lowest BMI for boys was in the Northern Harbour District and the highest in Gozo. In 2010 this changed to Northern District for the lowest BMI but still was highest in Gozo. For girls in 2008, the lowest BMI was in the Western District and the highest in the Southern Harbour District. In 2010 the pattern remained the same except that the highest BMI moved to South Eastern District. These differences were significant for boys only.

By school

Table 5 displays the summary statistics for BMI by school attended while table 6 details the distribution of overweight and obese boys and girls by school. Figure 1 depicts quartile ranges for the above. In 2008, boys attending independent schools were the least overweight and obese while those attending Gozo schools had the highest rate of overweight and obesity. Girls attending independent schools in 2008 had the highest rate of overweight and obesity and those attending Church schools had the least. This situation showed a marked reversal in the case of girls, with those attending independent schools being the least overweight and obese. These differences were significant for males only.

Table 3: *Percentage overweight and obesity of the same birth cohort (born 2001) by gender, over a 3 year period (Criteria WHO 2007)*

Year of assessment	**2007**	**2008**	**2010**
Mean age (yrs)	5.80	6.88	8.68
Males			
Total (*n*)	1792	1754	1558
Cutoff overweight (BMI)	16.75	17.10	17.75
Overweight (n)	369	304	430
Overweight (%)	20.6	17.3	27.6
Cutoff obesity (BMI)	18.25	18.75	19.75
Obesity (n)	349	301	317
Obesity (%)	19.5	17.2	20.3
Overweight + obese (n)	718	605	747
Overweight + obese (%)	40.1	34.5	47.9
Females			
Total (*n*)	1669	1680	1531
Cutoff overweight (BMI)	17.10	17.40	18.25
Overweight (n)	311	239	338
Overweight (%)	18.6	14.2	22.1
Cutoff obesity (BMI)	18.85	19.40	20.75
Obesity (n)	215	261	266
Obesity (%)	12.9	15.5	17.4
Overweight + obese (n)	526	500	604
Overweight + obese (%)	31.5	29.8	39.5

Discussion

The prevalence of obesity is rising at a very rapid rate worldwide and it is projected that 150 million adults and 15 million children will be obese by the end of 2010.3 The trend in obesity is especially alarming in children and adolescents. The annual rate of increase in the prevalence of childhood obesity has been growing steadily, and the current rate is 10 times that in the 1970s. This will contribute to the obesity epidemic in adults and creates a growing health challenge for the next generation. This comparative study shows that Malta is no exception.

The Health Behaviour in School Children (HBSC) study is a WHO 4-yearly initiative which assesses the health and lifestyle of children aged 11, 13 and 15.4 The 2006 HBSC study reported that Malta had the second highest proportion of obese or overweight children amongst 11 and 13 year olds second only to the USA, and the highest proportion of obese and overweight 15 year olds when compared to the 41 countries participating in the study. In all three age groups, between 28% and 31% of children had a self-reported BMI that was greater than 25.

Childhood obesity is an important predictor of adult obesity.5,6 Metabolic and cardiovascular risk profiles tend to track from childhood into adult life, resulting in an elevated risk of ill health and premature mortality.[7]

The differences in districts shown in this study are difficult to interpret due to the relatively small numbers. The previous significant incidence of overweight and obesity in boys living in the Southern Harbour district, found in 2007, has now petered out and all districts have shown more or less the same increase in overweight and obesity rates over the last 2 years.1 One may speculate that the rise in overweight and obese boys in Gozo, when compared to their Maltese counterparts, may be due a combination of more fast-food outlets sprouting up on the island and more academic pressure being enforced on Primary School boys in Gozo in order to guarantee entrance to

Table 4: *BMI Differences by gender and district*

	2008				2010			
	Boys		Girls		Boys		Girls	
	N Dist	Gozo	W Dist	S Harbour	N Dist	Gozo	W Dist	SE Dist
Mean	16.81	17.43	16.74	17.11	18.22	19.11	18.32	18.32
Standard Error	0.16	0.24	0.16	0.18	0.22	0.35	0.23	0.25
Median	16.32	16.85	16.05	16.25	17.29	18.04	17.17	17.28
Standard Deviation	2.52	2.78	2.65	2.95	3.36	4.07	3.63	3.89
n	264	132	272	270	227	137	258	242
t		-2.24		-1.55		-2.27		0.0045
p		0.013		0.06		0.01		0.5

the Junior Lyceum or to the only Church Secondary School on the island, enforcing a more sedentary lifestyle on these children. Furthermore, Gozitans have over the recent years, experienced a change in social behaviour from the rural to the more urban way of life with less time spent outdoors and more time in front of televisions and computers, as has the rest of the country. It might also be assumed that the more traditional and healthier Mediterranean Diet which was typical for Gozo families in the past, has given way to ready-made convenience and other energy-dense foods, as it has in Malta.

The school differences show that Independent Schools enjoy the least prevalence of overweight and obesity among both boys and girls. This was not so in 2008 when girls attending Independent Schools had a high prevalence for overweight but not obesity. However, this trend was significantly reversed in the 2010 study where the same girls became the least overweight and

Table 5: *Summary statistics for BMI by school attended*

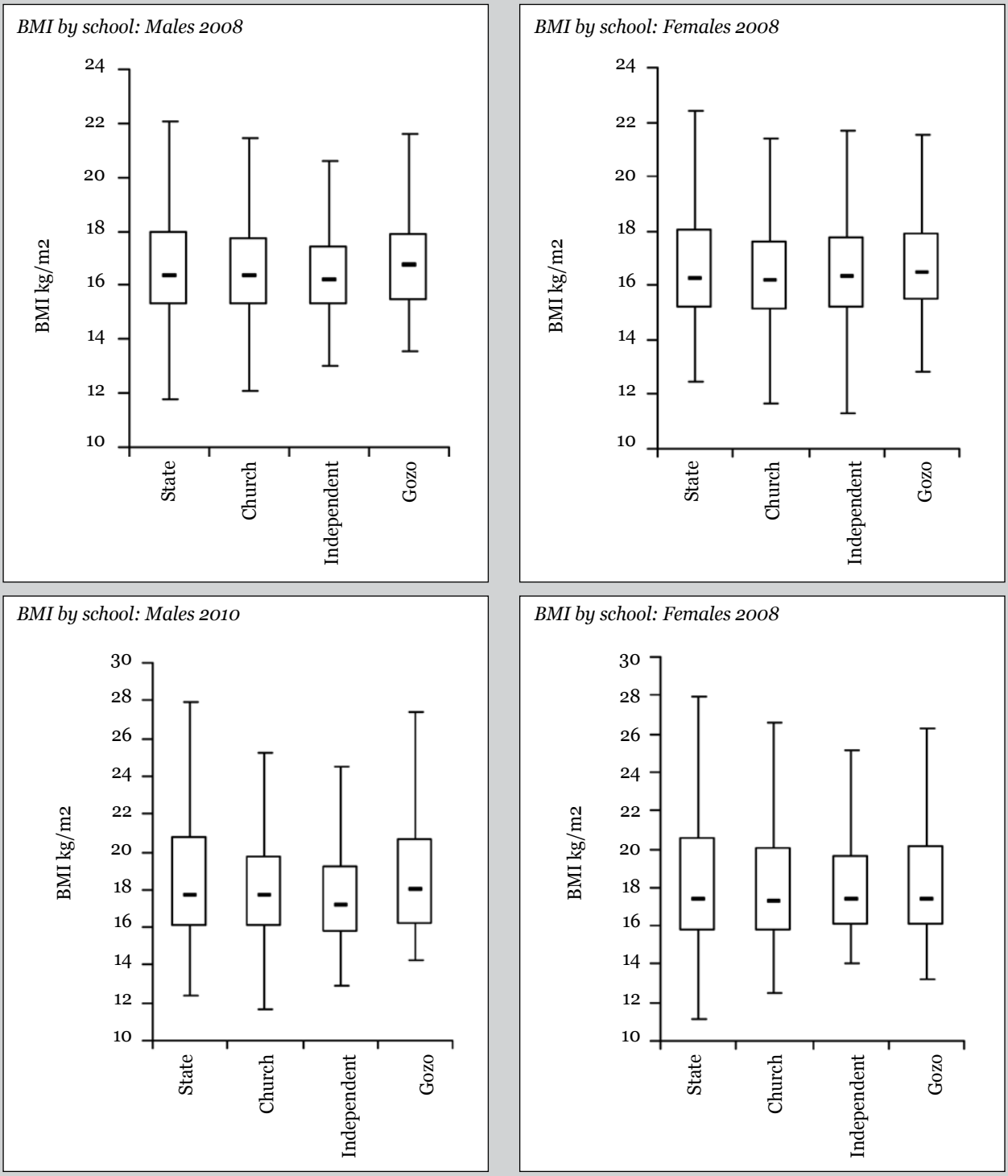
2008	**Males (*n*=1754)**				**Females (*n*=1680)**			
	State	**Church**	**Indep**	**Gozo**	**State**	**Church**	**Indep**	**Gozo**
Mean	17.2	16.8	16.5	17.2	16.9	16.7	17.1	17.0
Standard Error	0.1	0.1	0.1	0.2	0.1	0.1	0.3	0.2
Median	16.3	16.4	16.2	16.7	16.3	16.1	16.3	16.4
Mode	16.3	14.4	13.1	15.4	13.9	16.6	15.8	12.8
Standard Deviation	3.2	2.4	2.0	2.7	2.9	2.6	3.1	2.5
Sample Variance	10.0	5.9	4.1	7.4	8.2	6.6	9.7	6.2
Kurtosis	7.1	6.6	3.1	5.4	5.0	3.9	3.2	1.9
Skewness	2.2	2.0	1.4	1.9	1.8	1.7	1.6	1.3
n	1018	368	248	120	832	598	141	109
			F=5.2, *p*=0.001				F=1.1, *p*=0.4	

2010	**Males (*n*=1558)**				**Females (*n*=1531)**			
	State	**Church**	**Indep**	**Gozo**	**State**	**Church**	**Indep**	**Gozo**
Mean	18.9	18.4	17.8	18.9	18.5	18.2	18.7	18.5
Standard Error	0.1	0.2	0.2	0.3	0.1	0.1	0.4	0.3
Median	17.7	17.7	17.2	18.0	17.3	17.3	17.4	17.3
Mode	16.4	17.0	20.7	15.4	14.0	13.8	15.1	20.1
Standard Deviation	4.1	3.4	2.9	3.7	3.8	3.5	4.2	3.7
Sample Variance	16.7	11.6	8.5	14.0	14.7	12.0	17.4	14.0
Kurtosis	2.3	4.8	3.0	1.2	2.0	1.7	3.5	2.0
Skewness	1.4	1.7	1.4	1.3	1.3	1.2	1.9	1.4
n	894	342	198	124	716	578	115	122
			F=5.1, *p*=0.002				F=0.7, *p*=0.5	

Table 6: *Distribution of overweight and obese boys and girls by school*

		State			Church			Independent			Gozo		
		O/weight	Obese	Total	O/weight	Obese	Total	O/weight	Obese	Total	O/weight	Obese	Total
2008	Males	13.7	19.8	33.5	16.3	14.9	31.2	16.1	10.5	26.6	21.6	17.5	39.1
	Females	16.7	14.1	30.8	15.4	12.2	27.6	27.7	12.8	40.5	15.6	13.8	29.4
2010	Males	17.4	27.8	45.2	23.4	22.8	46.2	15.1	19.1	34.2	21.8	27.4	49.2
	Females	14.3	22.7	37.0	19.2	18.7	37.9	9.7	9.3	19.0	15.6	20.5	36.1

Figure 1: *Quartile plot of BMI by school for both genders and years studied (2008 and 2010).*



obese when compared to other schools. A survey of school sports facilities and time spent by children in physical activity per week in the different schools, was carried out as part of the European Child Growth Surveillance Initiative in 2008. This showed that Independent Schools had longer school days, and more time devoted to physical activity than State and Church Schools (Sammut A, Public Health Specialist - personal communication). This may be a contributing factor to the lower overweight and obesity rates seen in children attending Independent Schools. Another factor that should be taken into consideration is that parents of children attending Independent Schools tend to have a higher educational level and socio-economic status (WHO European Childhood Obesity Surveillance Initiative (COSI) – unpublished preliminary report – personal communication from VFS) and hence a heightened awareness of the consequences of overweight and obesity, and the ways in which to avoid these conditions. However, several studies show that the risk of obesity crosses all socio-economic and ethnic strata, despite being more prevalent in low income groups.[8,9]

The health consequences of overweight and obesity in children are not as clear as those for adults. Systematic review shows that childhood obesity is strongly associated with risk factors for cardiovascular disease and type 2 diabetes, orthopaedic problems and mental disorders. Many obesity related health conditions once thought to be applicable only to adults are now being seen among children and with increasing frequency. Examples of these include high blood pressure, early symptoms of coronary artery plaque formation, type II diabetes, non-alcoholic fatty liver disease, polycystic ovary disorder and sleep apnoea. In addition to the physical health consequences, severely obese children report a lower health-related quality of life. Childhood obesity is a highly stigmatised condition often associated with low self-esteem, and obese children are more likely than non obese children to feel sad, lonely and nervous.[10]

Obesity imposes an economic burden on society through increased direct medical costs incurred to treat the diseases associated with it, and indirect costs due to lost productivity because of absenteeism and premature death. In the European Region, the direct health care costs of obesity account for 2-4% of national health expenditure. The indirect costs could amount to twice those for direct costs.11 A cautious figure for the Maltese national health system has estimated that €20 million annually is currently being spent from the health budget as a result of the health consequences of overweight and obesity (Calleja N, Gauci D – paper presented at the Malta Medical School Conference, 2010, personal communication). This figure will continue to rise if the current trend in the prevalence of overweight and obesity in our child population remains unrestrained and indeed, in the 2007 study, it was estimated that this figure would realistically climb to €70 million within a few years.[1]

Obesity is a complex entity and cannot be viewed simply as a health issue. Health education is effective in disseminating knowledge and increasing motivation to change attitudes, but is highly unlikely to achieve sustained behavioural change on its own.

In its document The Challenge of Obesity in the WHO European Region and the strategies for response published in 2007, the World Health Organisation advises that measures to combat obesity need to be undertaken by a range of entities such as agriculture, transport, commerce and industry, education, the mass media and communication. Without this cross-sector collaboration success in controlling and indeed, reversing the obesity epidemic cannot be achieved. No single action will reverse this epidemic but there is no doubt that improving eating habits and increasing voluntary and involuntary daily physical activity are two critical strategies. Tackling the causal factors of obesity at an early stage requires a multi-sectoral and multifactor approach.

Furthermore , a strong evidence base of data must continue to be built in order to track the success of interventions. Hence, continuous monitoring of key indicators such as children's height and weight is essential. This study has followed up one national cohort of Maltese children over three years. The same cohort will be followed up again in 2012. Whilst additional studies to identify the precise causes of obesity will be useful, specific actions can and should be integrated in order to prevent or at least limit, and address obesity within Maltese society. The development of this integrated approach would help to track the effectiveness of interventional or prevention strategies and provide an anchor by which policy makers can implement suggested actions.

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