A cross-sectional survey of Maltese children's physical health during the Coronavirus pandemic lockdown

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BACKGROUND

Home-schooling was imposed by many countries in Europe because of the Coronavirus pandemic. This became the new lifestyle for most children, with potentially significant impact on physical activity, sedentary behaviours, weight status and sleeping habits.

METHODS

A seven-day recall questionnaire was distributed on local social media groups in Malta. Parents with children under 16 years of age were invited to anonymously fill the five-minute questionnaire on a voluntary basis. Responses were collected over a one-week period in June 2020.

RESULTS

492 valid responses were assessed for children aged 1-15 years (divided into Pre-Primary, Primary and Secondary school-age groups). Of those, only 16.9% of children attained the recommended daily physical activity during the pandemic. 34.6% of all children were found to be overweight or obese. Furthermore, obese children were noted to be significantly less active (p=0.028). Home-schooling averaged 3.25 hours per day in Primary and 3.6 hours in Secondary schoolchildren. Additionally, 95% of children spent at least 2 hours in sedentary activities and longer hours were noted in obese children (p=0.040). The average daily vegetable and fruit intake was 4.21 portions. The sleep duration was 9.9 hours. 57.4% of children had an electronic gadget in their bedroom.

CONCLUSION

Physical inactivity, increased sedentary behaviour and increased food intake were the main contributors of increased BMI in Maltese children during the Coronavirus pandemic. A better balance of home-schooling hours, physical activity and nutrition should be advocated as a strategy to prevent childhood obesity especially if countries revert/retain home-schooling for the foreseeable future.

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INTRODUCTION

The SARS-CoV-2 pandemic has affected all nations worldwide and every aspect of human activity. Nations have been put on forced lockdown, barriers were put up and life as we knew it changed drastically. Malta was not exempt, and the local lockdown mandated that everyone, including children, were required to stay indoors. The educational services and teachers rose to the challenge and provided home-schooling. However, this had major implications on lifestyle change, and an evaluation of the children's health during the Coronavirus pandemic was required. Although schools re-opened in April 2021, many 'vulnerable' children were still not attending. Any information relating to the impact on the general health of the whole paediatric population during lockdown/home-schooling, would be imperative, and upon which any improvements needed if Malta is constrained revert to home-schooling becomes the 'norm'.

Children's physical health can be subdivided into four domains: physical activity, sedentary behaviour, nutrition and sleep. All are very important in maintaining a healthy lifestyle.

Physical activity (PA) is defined as bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level and can involve anything from daily household chores to structured exercise and sport.[1] The World Health Organization (WHO) have published global recommendations on PA for health,[2] stating that children between 5 and 17 years should accumulate at least 60 minutes of moderate-to-vigorous physical activity (MVPA) daily in multiple short bouts. Despite this, the 2013/2014 Health Behaviour in School Children (HBSC) Study,[3] showed that not even a quarter of Maltese children achieved the recommended 60 minutes of MVPA a day, girls were less active than boys, and MVPA decreased with increasing age.

Sedentary behaviour, such as playing video games, watching television and browsing the internet, are widely linked to obesity in children.[4–7] Conversely, being physically active, protects from developing weight problems,[8] reduces the risk of chronic disease, enhances academic performance, cognitive function, self-esteem and body image.[9] In fact, physical inactivity is identified by WHO as the fourth risk factor of global mortality.[10] WHO, the American Academy of Paediatrics (AAP) and the Centres for Disease Control and Prevention (CDC) all recommend that sedentary screen time should be no more than 1 hour a day.[11-12]

Fruits and vegetables are widely accepted as important components of a healthy diet. Reduced consumption of fruit and vegetables is linked to poor health and increased risk of non-communicable diseases including cancers, obesity, diabetes and cardiovascular diseases.[13] WHO/FAO published a report in 2004 recommending a minimum of 5 portions (400g) of daily fruit and vegetables.[14]

Sugar-sweetened beverage consumption is elevated worldwide and contributes to the overall energy density of diets in view of the large amounts of sucrose or fructose that these drinks contain.[15] WHO recommends reducing the consumption of free sugars to less than ten percent of the total energy intake.[16]

Sleep is an important, often neglected, aspect in children's physical health. Inadequate or poor quality sleep during childhood affects the developing brain's emotional and cognitive functions and increases the risk of obesity.[17]

Consensus recommendations from AAP and the American Academy of Sleep Medicine (AASM) advise on age-dependent sleeping hours.[18] Technology gadgets in the bedroom during early childhood have been associated with decreased sleep.[19]

Growth is the best indicator of health and can be assessed accurately using established anthropometric measurements. It has been extensively applied to the valuation of health and nutritional risk, especially in children.[20]

The objective of this cross-sectional survey was to assess children's physical health status within various domains, during a pandemic-driven lockdown situation resulting in home-schooling to implement informed and adequate planning for future needs.

MATERIALS AND METHODS

Participants

Participants were recruited by posting the link to the Google Forms questionnaire on various local parent groups on Facebook, the Maltese Paediatric Association Facebook group, as well as on individual paediatric doctors' Facebook platforms. The target participants were the parents and carers of children living in Malta under the age of 16 years of age. They were invited to fill in the five-minute questionnaire on a voluntary basis and anonymously. All responses were included unless the discrepancy between the child's age, height and weight input was such that an error was likely (e.g., a 10-year-old boy reported to weigh 12 kg, or a 9-year-old girl with a height of 1m).

Questionnaire details

A self-administered, 7-day recall questionnaire was formulated to aid parents in their recollections of children's activities. The questionnaire contained five subsections that

included questions on physical activity, sedentary behaviour, nutrition and preferred beverage, anthropometric measurements and sleep. The majority of the questions were tick-based on Likert-like scales for increased compliance. Each question/section had to be answered before proceeding to the next section and final submission. Parents were asked to input the age, height and weight of their children. Parental perception of children's weight status and comparisons of food intake, physical activity and body mass were linked to their children's pre-pandemic status. Responses were collected over 7 consecutive days in June 2020, after 3 months of a national-imposed lockdown and change to home-schooling. For all participants, BMI z-score was calculated using the AnthroPlus software (v1.0.4),[21] using measurements provided by the parents. The study protocol was approved by the local university's Research Ethics Committee. The full questionnaire can be found at: https://docs.google.com/forms/d/e/1FAIpQLS c6qYD7_q1iCsjxvuHViF8UB3J504fRND9soOz oZBVwy9EomQ/viewform.

Age groups

Since the age range for participants varied between 1 year and 15 years, the children were further subdivided into groups including Pre-Primary school age for 1 to 5 years, Primary school age for 6 to 11 years, and Secondary school age from 12 to 15 years.

Weight status

Obesity status in the children was defined using 2007 WHO child growth reference charts of BMI-for-age for 5-19 years.[22-23] Overweight was defined as a BMI z-score greater than +1, whereas obesity was defined as a BMI z-score greater than +2.

Statistical procedures

Questionnaire responses were analysed with IBM SPSS v25, 64-bit edition for Windows (SPSS Inc., Chicago, IL). Analysis included descriptive statistics for frequency of variables and examination of multiple responses. Parametric comparison of means was used to compare metric data between groups. Chi-square test confirmed significant discrepancies between parents' perception of their children's weight and their actual weight status, whereas one-way ANOVA were used to analyse relationships between categorical variables such as the average sleep duration and the child's weight status and the average MVPA achieved and child's weight status.

Descriptive

A total of 521 responses were collected. However, 29 were excluded from the study due to clear errors relating to data input in the children's height, weight or age. 492 responses were included, of which 262 were boys (53%) and 230 were girls (47%). The age range of the children varied between 1 and 15 years. These were then subdivided into Pre-Primary (1-5 years), Primary (6-11 years) and Secondary school-age children (12-15 years) (Figure 1).

Figure 1   Descriptive representation of the children's age taking part in the questionnaire. Mean =6.87y, SD=3.324, *n*=492
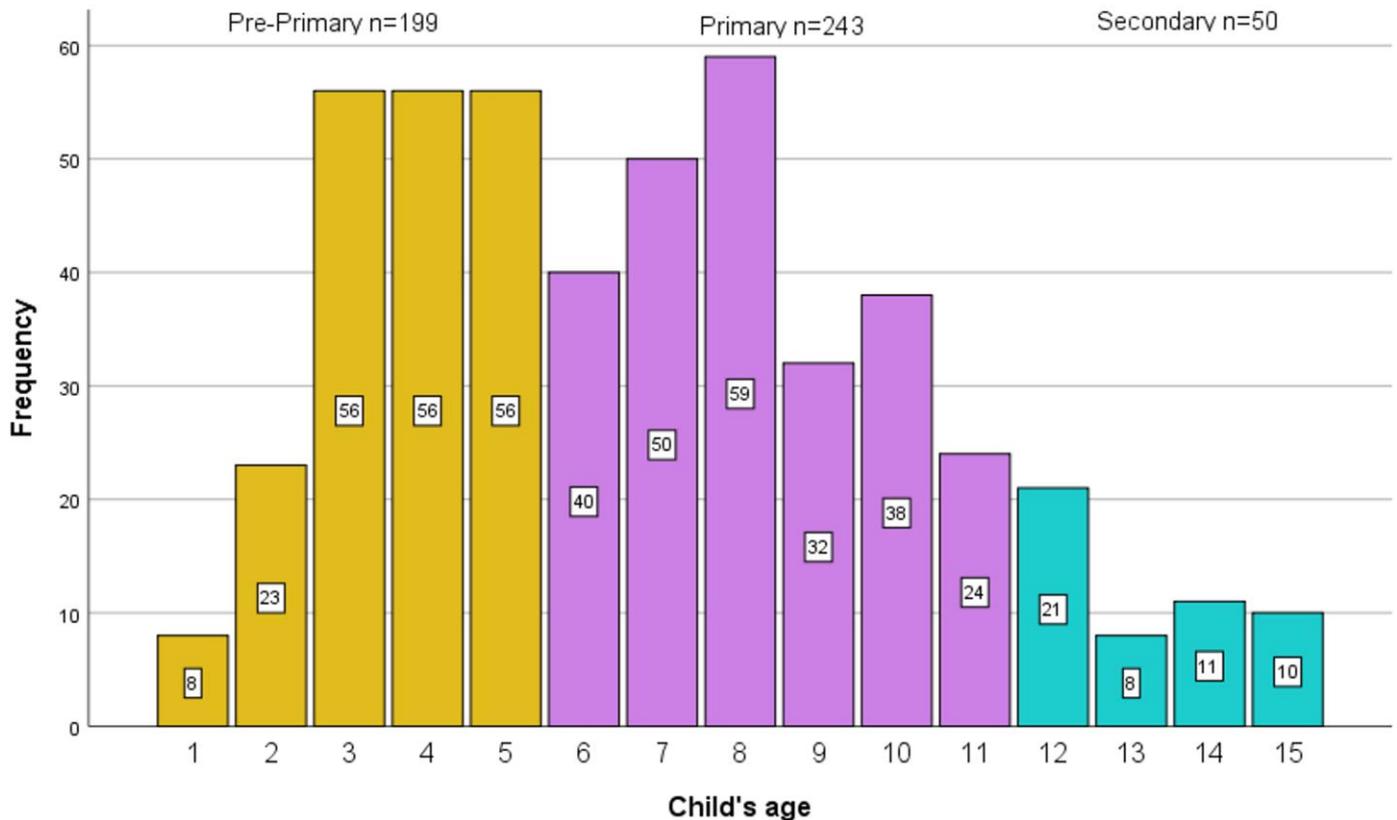
Children's body mass index (BMI)

The BMI z-scores for the children in this questionnaire were calculated based on the weight and height provided by the parents, together with gender and age. The mean BMI z-score was 0.37 (SD=1.719). 45% of children had a normal weight, a total of 35% were overweight (18%) or obese (17%) and 20% were underweight (Figure 2). No significant difference between weight status and gender (p=0.966) was noted.

40% of parents claimed that their children's weight was between 1-2kg lower at the start of the pandemic, 8% claimed their children's weight was 3-5kg lower, whereas 46% claimed it remained the same. Overweight or obesity was mostly observed in children aged between 3 and 8 years of age (67%), with Secondary school children making up 9% of the overweight or obese cohort.

A comparison was made between the actual weight status of the children and the parents' perception of their children's weight: 86% of parents perceived their child's weight as acceptable, and only 9% thought their children were overweight or obese. Chi-square testing confirmed significant discrepancies between parents' perception of their children's weight and their actual weight status ($\chi^2(6) = 115.78$, p<0.001). Less than a quarter of parents whose children were overweight or obese, correctly identified them as such.

**Figure 2**   Figure showing weight status according to age groups
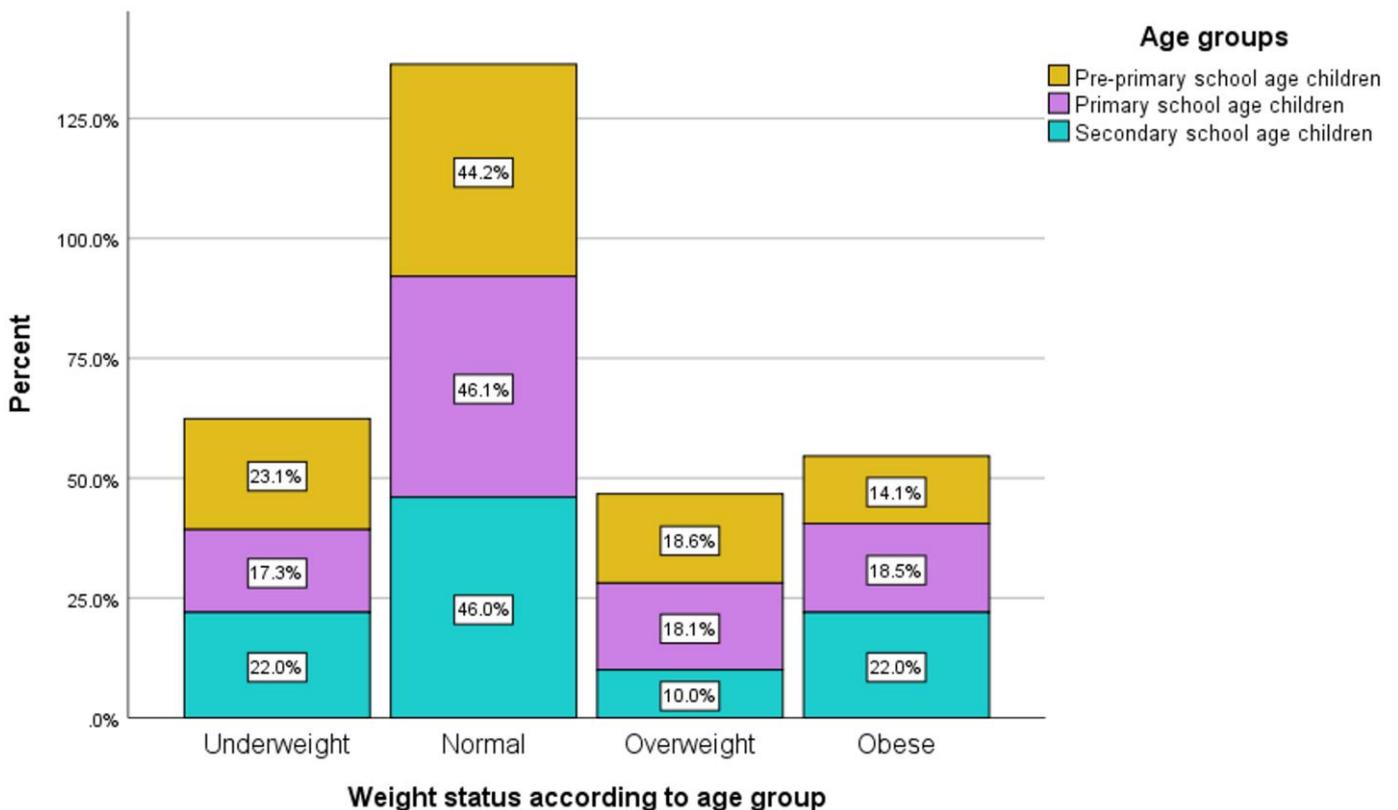
Physical activity

During the study period, the average number of days during which 60 minutes of moderate-to-vigorous physical activity (MVPA) was achieved was 3.64 days out of 7 (Figure 3a and Table 1). Only 18% of boys and 15% of girls (17% of the total number of children), managed to achieve a daily MVPA of 1 hour during the previous week. Boys were, on average, slightly more active than girls (3.71 days *vs* 3.56 days per week), but the difference was not significant (*p*=0.407).

There was a decrease in the daily achievement of 60 minutes of MVPA during the pandemic when compared to the lifestyle before the pandemic. Parents reported a higher MVPA activity before the lockdown, with 21% achieving 1-hour MVPA daily *vs* 17% after lockdown. Moreover, prior to the pandemic, 54% of children were able to achieve the daily recommended MVPA at least 5 days a week or more (Figure 3b), but this decreased to 32% during the pandemic (Figure 3a).

Figure 3A   Number of days in which children achieved >60 minutes of MVPA over the previous week during the Coronavirus pandemic
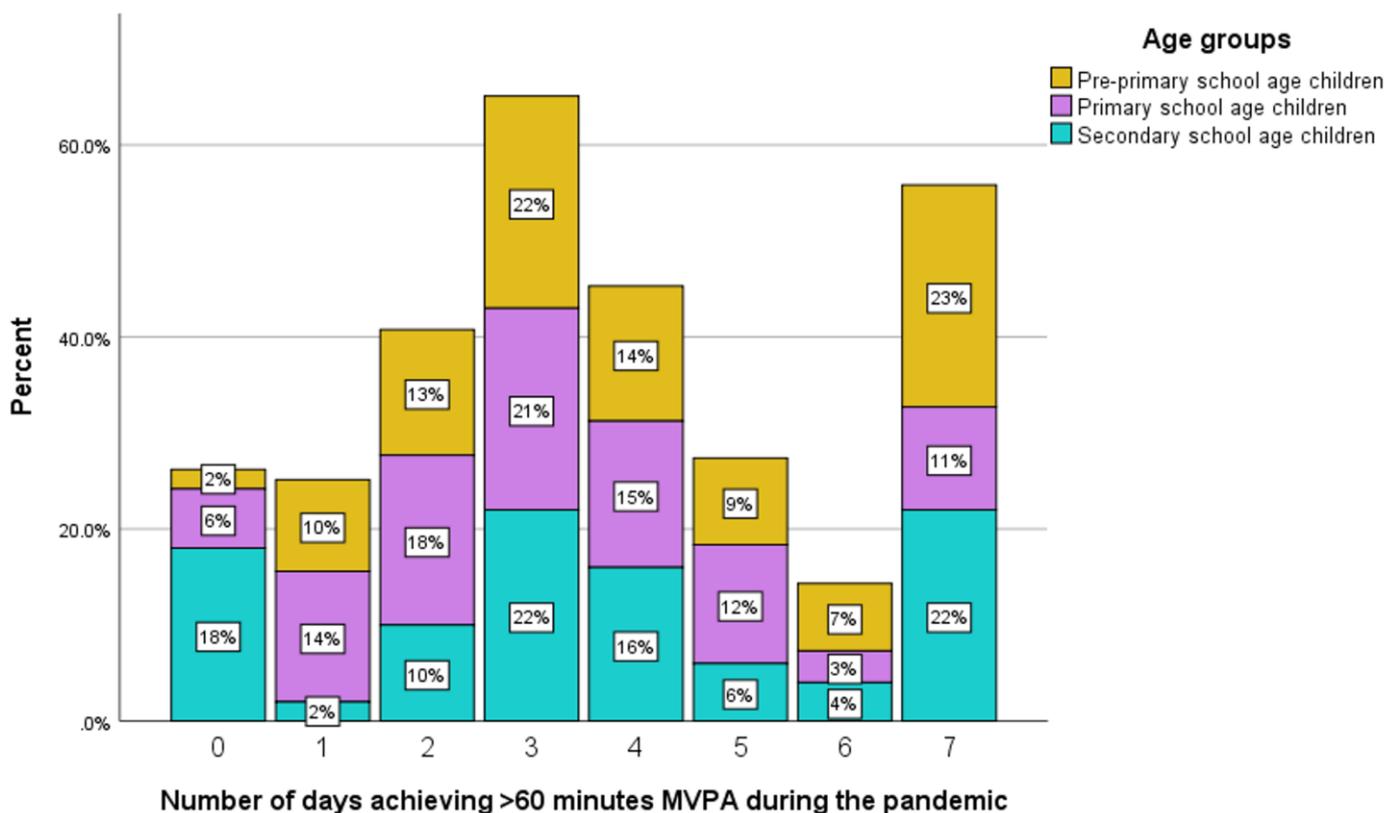
Table 1 Daily MVPA, hours of home-schooling, hours in sedentary activities, fruit and vegetable portions, sleep and number of gadgets in the bedroom for different age cohorts.

	Pre-primary school age (1-5 years)	Primary school age (6-11 years)	Secondary school age (12-15 years)
N	199	243	50
1-hour MVPA (days out of 7)	4.08 (2.096)	3.29 (1.965)	3.60 (2.416)
Home-school (hours)	1.48 (1.424)	3.25 (1.371)	3.64 (1.549)
Sedentary activities (hours)	3.61 (1.844)	4.46 (1.803)	5.14 (2.222)
Vegetable portions	1.91 (1.422)	1.93 (1.565)	2.40 (1.591)
Fruit portions	2.44 (1.416)	2.09 (1.386)	2.24 (1.403)
Sleep duration (hours)	10.17 (1.017)	9.88 (1.000)	9.20 (1.067)
TV (% use before bed)	19 (39.0)	23 (0.425)	30 (0.463)
Mobile phone (% use before bed)	2 (14.11)	16 (37.2)	66 (47.9)
Tablet (% use before bed)	18 (38.2)	24 (42.7)	14 (35.1)
Computer or laptop (% use before bed)	2 (14.1)	11 (31.0)	44 (50.1)
Video game consoles (% use before bed)	1 (10.0)	9 (28.2)	26 (44.3)

Number within brackets shows the standard deviation of the variable. MVPA = moderate-to-vigorous physical activity.

Figure 3B Number of days in which children achieved >60 minutes of MVPA before the pandemic
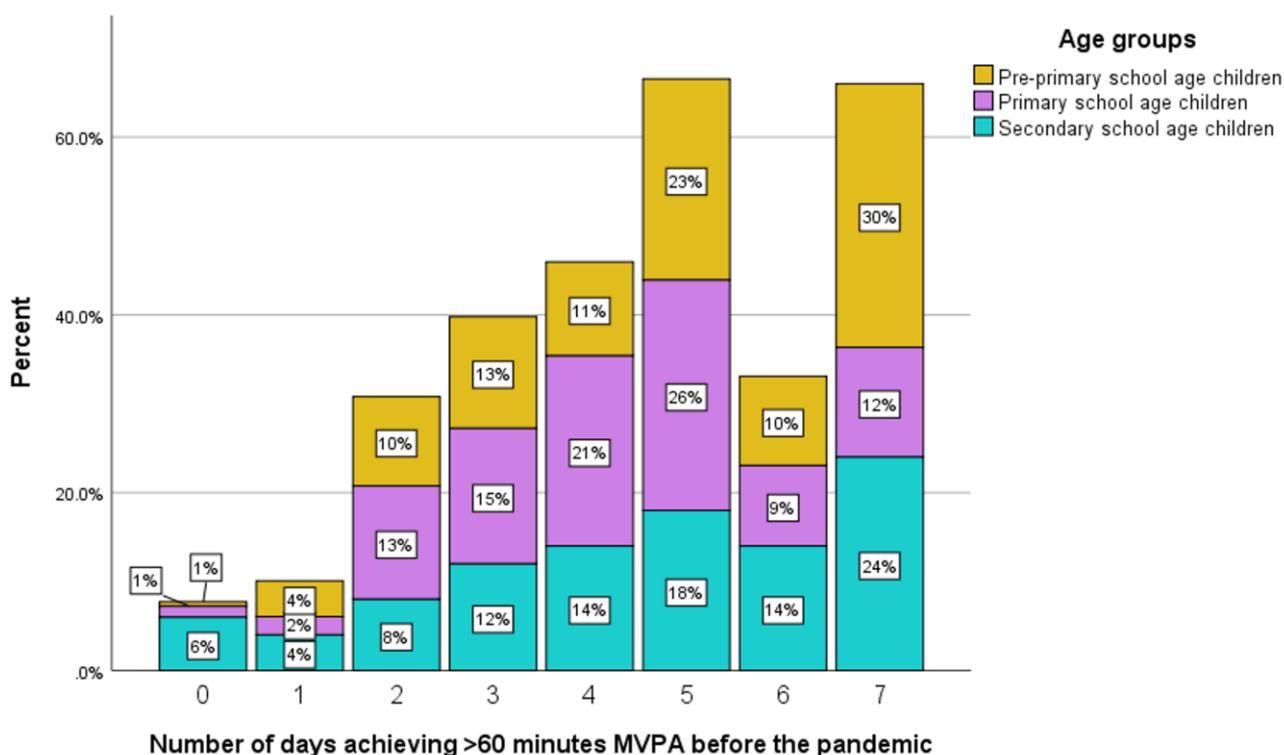
The most common PA performed during the lockdown was walking (48%), closely followed by running (45%), swimming (30%), home exercises (27%), cycling (24%) and dancing (22%). When PA was assessed according to weight status, it was noted that obese children, with a BMI z-score of over 2, were the least active. The study reported that obese children were active 3.0 days out of 7.0 days, overweight children were active 3.9/7.0 days and normal and underweight children were reported to be active for 3.7/7.0 days (Figure 4). The differences between group means were statistically significant (F(3,488) = 3.050, p=0.028). For the whole group, one hour of MVPA was only achieved in 3.64 days (SD=2.096) out of 7. Post hoc comparisons using the Bonferroni test indicated that the mean score for weekly MVPA in the obese group (Mean(M)=3.02, Standard Deviation (SD)=2.16), was significantly less than the weekly score for the overweight group (M=3.87, SD=2.00, standard error of the mean (SEM)=0.32, p=0.049, and normal group (M=3.74, SD=2.07, SEM=0.26, p=0.034.). Of those children who managed to be active for an hour a day, 60% had normal weight, 11% were underweight, 17% were overweight and 12% were obese (p<0.001).

Figure 4   Mean days of MVPA per week according to weight status
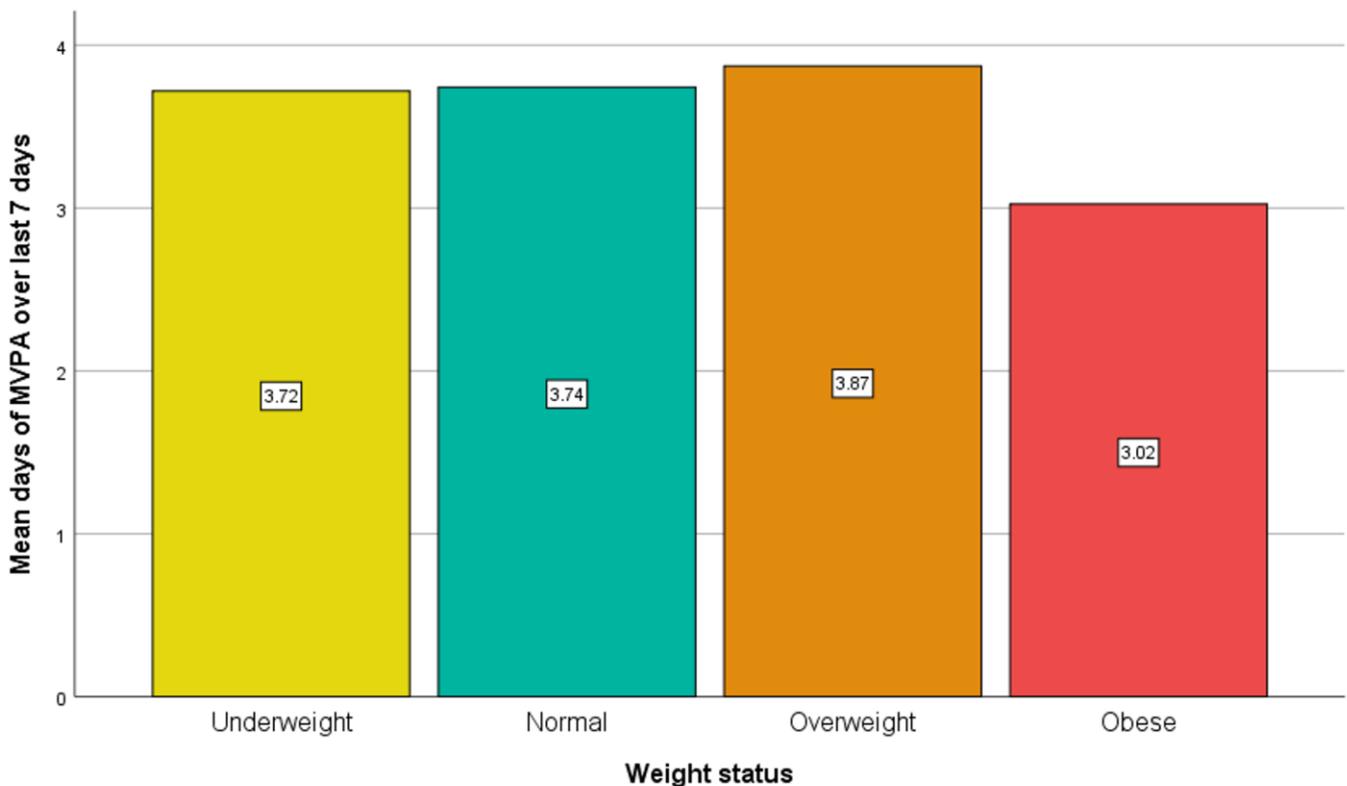
Sedentary behaviour

i. Home-schooling

The mean number of hours of daily home-schooling was 2.57 hours (SD=1.675 hrs) (Table 1). Just 13% of children had an average of 4 hours of home-schooling during the weekdays, and 18.9% of children (n=93) received 5 hours or more, the majority in the junior years of primary school (Years 1-3).

ii. Sedentary activities

In addition to the number of sedentary hours spent on home-schooling, during the Coronavirus pandemic children also spent a significant amount of their leisure-time undertaking sedentary activities (Figure 5).

Almost 95% of children in this cohort spent at least 2 hours or more doing various activities sitting down (Table 1). Moreover, 70% of parents confirmed that their children were more sedentary during the pandemic when compared to their 'normal', pre-pandemic lifestyle. Furthermore, obese children had a significantly increased daily mean of 4.68 of sedentary hours, compared with 4.27 hours in overweight children, 4.07 hours in those with a normal weight, and 3.79 hours in underweight children (F(3, 488) = 2.792, p=0.040).

Figure 5   Daily average number of hours children spent sedentary during home-schooling and leisure activities.
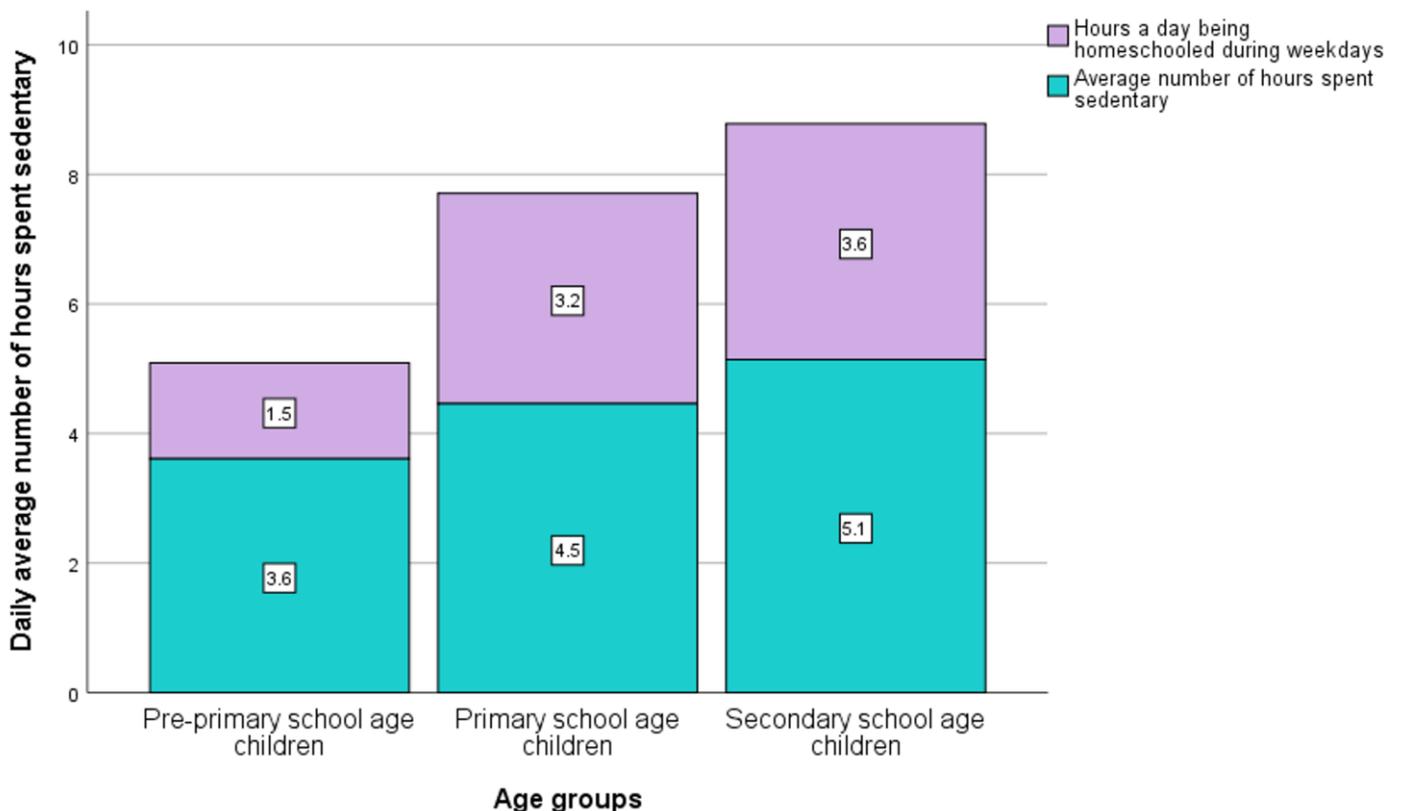
Children's nutrition

i. Fruit and vegetables

The mean number of daily portions was 1.97 portions (SD: 1.515) for vegetables and 2.24 (SD: 1.403) for fruit, for a total of 4.21 portions (out of 5) (Table 1). 18% of children did not take vegetables regularly, whereas only 9% of children did not take regular fruit portions. There was no association between the intake of fruit and vegetables with weight status (p=0.359 and p=0.510, respectively), gender (p=0.262 and p=0.579), and age (p=0.219 and p=0.569).

ii. Beverages

The preferred beverage was water (94%), followed by milk (34%). Sugary drinks such as juice, iced tea and soft drinks were the preferred beverage amongst 14% of children but, in this study, this was not statically associated with the child's weight (p>0.05).

iii. Meals and snacks

Over 88% of children ate three main meals during the pandemic, with lunch being the most popular (93%). In addition, more than half the children ate two snacks a day.

83% of parents claimed that the previous day's food intake was the usual amount their children were eating during the pandemic. Furthermore, 27% of parents noted that their children were eating more food during the pandemic than they usually ate pre-pandemic.

Sleep

The mean number of hours of sleep within this cohort of children was 9 hours 56 minutes (SD: 0.04), but this did not alter significantly when comparing with reported pre-pandemic sleep patterns (F(3,488) = 0.565, p=0.613) (Table 1).

A majority of children (57%) had an electronic gadget in their bedroom, but there was no link with the child's weight status. The most common was a TV (17%), followed by a tablet/iPad (15%), and a mobile phone (12%).

DISCUSSION

Despite having more free time at their disposal, children in this study cohort spent less time doing adequate physical activity (PA) during the pandemic-associated lockdown. Only 17% of the children in this cohort achieved the daily MVPA recommendations. This can be noted from the parents' pre-lockdown PA report in which 21% of children achieved the daily MVPA recommendations. These figures tally with the latest HBSC Study carried out in 2013/2014 in Malta, which showed that only 21% of 11-year-old girls and 28% of 11-year-old boys achieved the recommended hour of MVPA a day. In this group, girls were less active than boys and MVPA decreased with increasing age (WHO, 2016).

In 2014, the HBSC study also reported alarmingly high figures of daily television-watching of two hours or more during weekdays (sedentary behaviour) amongst Maltese youths, including 50% in 11-to-15-year-old girls and 58% in boys. Although alarming, these rates are relatively small compared to those found in this study with 96% of 11-to-15-year-old Maltese girls and 93% of boys spending more than 2 hours of daily screen time during the lockdown period.

Home-schooling, regardless of any pandemic, has become increasingly popular. Despite home schooling not having any legal basis in many countries, the total number of home schooled children in the world at the beginning of 2020 was still under three million, constituting 6% of school-age children.[24] A

number of publications have analysed home-schooling with body composition, PA and cardiovascular risk and have already established a decrease in unstructured PA, an increase in anthropometric measurements and increased cardiovascular risk in home-schooled children. [25-26] This study has supported these findings since BMI z-scores increased, there was a reduction in overall PA and an alarming increase in sedentary activities outside from the actual hours spent being home-schooled.

Maltese children preferred to eat fruit slightly more than vegetables, and during the lockdown, children have been shown to have increased their intake of fruit and vegetables,[3,27] although not to recommended amounts. On average, the intake was around 84% of the recommended five portions of fruit and vegetables a day. This could be the result of an increased availability of fruit and vegetables at home during the lockdown.

The preferred beverage of Maltese children was water (94%) with only 14% who reported a preference for sugar-sweetened beverages in addition to water. This was a positive improvement from the data portrayed in Food and Nutrition policy and action plan for Malta in 2015 [28] that reported an average of 44% of youths admitting to drinking sugar-sweetened beverages on a daily basis. A potential reason for this was the enforced relocation of food and beverage consumption to home rather than from restaurants or take-aways.

Most Maltese children ate their three main meals every day in addition to two further snacks. More than a quarter of parents noted that their children were eating more food during lockdown, perhaps because of the immediate availability of food throughout the day. Eating out of boredom could also attribute to being stuck at home during the lockdown.

In this study, 33% of pre-Primary school children, 36.6% of Primary school children and 32% of Secondary school children were overweight or obese. The figures were somewhat less than those reported by Grech and colleagues within the national BMI study in 2017, who found that 40% of primary schoolchildren and 43% of secondary schoolchildren were overweight or obese.[29] A potential reason for this was the under-representation (10%) of secondary school-age children in this study. The figures in this study are likely to be underestimates and, indeed, the pandemic has had a negative impact on children's weight and, in this study, 40% and 8% of parents claimed that their children's weight was between 1-3kg and 3-5kg lower three months before the pandemic, respectively.

The pandemic has forced almost all extra-curricular activities and social occasions to be suspended. This had a positive effect on children's sleep, and most children achieved the appropriate hours of sleep as recommended by the AAP and AASM.[18] To-date, there have been no previous studies carried on the amount of sleep in Maltese children, hence comparisons to pre-pandemic times were not possible. However, although electronic gadgets negatively influence the quality and duration of sleep, the high proportion (57%) of Maltese children who had tablets, laptops, video games, mobile phones or a TV in their bedroom was cause for concern.

Limitations

This study was a retrospective and not case-controlled study. Furthermore, it was not population representative, since it was

dependent on reporting only by those individuals who were selected from existing social platforms, were able to access the questionnaire and sufficiently motivated to reply. Parents who did not frequent social media platforms would have missed the opportunity to fill in the questionnaire altogether. The percentage response rate, as a reflection of the population at large, could not be calculated. Furthermore, the study included a relatively small number of children and had only two comparative points in time namely during the pandemic and before the pandemic. Another important limitation to this study was that there was no prior validation of the questionnaire, and a pilot study was not carried out. Moreover, collection of the study data was dependent on parents inputting the height and weight of their children correctly, and any subject to inherent error and subjective bias. A number of data entries (n=29) were selectively excluded from the analysis due to 'unlikeliness/impossibility' of the anthropometric measurements provided vis-à-vis the child's age (for example, a 9-year-old girl whose height was reported as 1m). Results may have been skewed, however, Z-scores were not used to exclude such errors so that subjects at the extreme tail ends of the distribution curve, were not automatically removed. Furthermore, there was an under-representation of secondary school-age children (only 10% of the participants), a group already known to have some of the greatest obesity-related problems in the country.

Despite the numerous limitations, the study was able to show definite trends in children's health that were caused by the SARS-CoV-2 pandemic. This included several positive developments, including the increase in the duration of sleep in all age groups and increased fruit and vegetable intake. On the downside, these were outweighed with worrying trends showing an overall increase in food intake, an increase in children's BMI as a result of decreased daily MVPA activity, and an increase in sedentary activity during the period of home-schooling.

CONCLUSION

Childhood obesity is a severe, global nutritional problem, and Malta has the highest percentage of 11, 13 and 15-year-old children who are overweight and obese. The Coronavirus pandemic has imposed home-schooling on most children worldwide, including Malta. In this study, the lockdown did not negatively impact children's sleep patterns and may have promoted an increase in fruit and vegetable intake although not to recommended amounts. However, this study also showed that enforced lockdown resulted in increased weight gain in Maltese children, probably contributed to by decreased levels of MVPA, increase in sedentary behaviour, and increased food intake. Future planning of children's education in Malta, including both structured and unstructured PA in school or at home, must include this important public health issue within the curriculum, as part of a National strategy to fight against childhood obesity.

SUMMARY BOX

What is already known?

- Childhood obesity is a worldwide epidemic with very high rates found in Malta.

- The Health Behaviour in School Children (HBSC) Study carried out in 2013/2014, showed that only 21% of adolescent Maltese girls and 28% of adolescent boys achieved the recommended hour of MVPA a day.

- The same HBSC study also reported alarmingly high figures of daily television-watching of two hours or more during weekdays (sedentary behaviour) amongst Maltese youths, with 50% in 11-to-15-year-old girls and 58% in boys.

New findings from this study

- The lockdown had a positive impact on amount of sleep, decreased sugar-sweetened beverage intake and increased fruit and vegetable consumption in Maltese children.

- Less children (17%) achieved the recommended 60 minutes of MVPA during the lockdown and obese children were found to be significantly less active.

- Over 95% of children spent an additional 2 hours or more in sedentary activities (excluding home-schooling).

- Increased food intake and rising prevalence of overweight and obesity in children were observed.

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