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Original Article

Relationship between the use of multimedia devices, BMI, and sleep in 0–6-year-old children during the first phase of the COVID-19 health emergency in Italy

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Abstract
Background: In today's technological society, children are exposed to electronic devices from an early age. During the Italian national lockdown from 8th March to 3rd May 2020 (56 days) in response to Covid-19, screen time increased significantly due to people's confinement at home and their consequent inability to physically interact with others. Virtual communication has provided some compensation to the problem of social distancing but at the same time, it has increased the amount of daily time both adults and children spend in sedentary activities, in contradiction to the daily movement and physical activity targets prescribed in the WHO guidelines. This preliminary research has investigated whether the highly sedentary lifestyle induced by theCovid-19 lockdown, combined with an increase in screen time, affected the sleep and Body Mass Index (BMI) of children aged 0-6 years. **Methods**: An anonymous questionnaire containing32 questions was sent by e-mail to parents of children aged 0-6 years. Where parents had more than one child, they were asked to fill in a form for each child. **Results:** Considering all the study subjects (n=125), there was no significant relationship between screen time and BMI in children aged 0-6 years (r=0.09) and between screen time and hours of sleep (r=-0.03). **Conclusions:** Despite the fact that during the period of health emergency the lockdown reduced the opportunities for movement and the physical activity prescribed by the WHO guidelines, no significant changes were found in the relationships between screen time and hours of sleep and between screen time and BMI. The high percentage of children with habits that conflict with those suggested by the WHO guidelines, both in terms of sleep and screen time, suggests that there is a need to increase parental awareness of the importance of the WHO health recommendations. It is important to attempt to subvert the constant demands of children to spend many hours sitting in front of a screen, by daily encouraging more dynamic play activities that involve greater expenditure of physical energy.
Keywords: Screen time, BMI, childhood, Covid-19, lifestyle.

Introduction

Technology has become an integral part of every family's daily life and people have easy access to digital devices (computers, tablets, smart phones, televisions, etc.) from an early age. Infants and young children are exposed to electronic devices from a young age with this introduction to technology seemingly being mainly conveyed by their parents.

With the passing of the years and progress, people have devoted ever less space in their lives to physical exercise, preferring a sedentary lifestyle; in young people this way of life is associated with a diet high in calories and fats that contributes to an increase in body weight and fat mass to the point where weight and obesity become an issue. Between the ages of 3 and 11, physical activity in school has a fundamental role in children's wellness and healthy status(D'Isanto et al., 2010).Physical activities are the foundation of all learning and accompany personal development at every stage (Altavilla, 2016), but the last decade has seen a large-scale introduction of pervasive computing among sport-related technologies.

According to Raiola (2017) the process of learning movement involves developing cognitive structures, known as motor programs, through the processing of information. These processes provide the opportunity to make comparisons in real time, through closed-loop motor control, or later, through open-loop motor control theory, and to obtain results, triggering a process of adjustment and refinement of movement.

Screen Time and Physical Activity

Physical activity (PA) and sedentary behaviours (predominantly screen time) have a direct impact on children's weight status. Research evidence suggests that helping young children establish an active lifestyle can prevent them from becoming overweight and obese (Biddle& Pearson, 2011). Otherwise in the last years, new discoveries on the brain have changed the scientific scenario of psycho pedagogy theories concerning how the mind functions in the movements and how the children learn trough the motor activities (Raiola, 2012).

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The association between TV time and overweight and obesity among youth may be due to a number of factors, including unhealthy eating, the biological effects of sitting, spending less time being physically active, or some combination (Lou,2014)

According to Xu et al. (2015), children's levels of physical activity are influenced by the amount of physical activity undertaken daily by their parents and the extent to which they are sedentary, and by parents' knowledge of the WHO guidelines on PA for children. The study found that children who received more parental encouragement to engage in playful physical activity during the day had higher levels of PA than children who were neither encouraged nor motivated to exercise. Children who were given rules to follow in terms of organizing their daily routines and were set a limit on screen time were more likely to participate in outdoor play activities.

In addition, a positive correlation was found between the PA levels of parents and their children: physically active parents significantly influence their children's PA, thus determining their level of sedentariness. According to Kaur et al. (2019), the amount of time spent in front of the TV or computer screen in subjects under 5 years of age is directly proportional to the level of sedentary behaviour in children. Furthermore, screen time is one of the main causes of non-communicable diseases and the exponential increase in health-related risks in older people.

There is a rapid increase in time spent in front of the TV once children reach the age of one. It has been shown that children who spent less than one hour a day in front of the screen at 14 months, spent more than two hours in front of the screen by the age of 30 months. Cheng, et al. (2010) found that 29.4% of 18-month-olds and 24.5% of 30-month-olds watched TV for 4 hours or more per day. In addition, children under two years of age who watched TV for any length of time per day and children over two years of age who watched TV for more than two hours per day were more likely to show a delay in their motor skill development. The consequences of increased screen time can manifest either early or late: early consequences are considered as those reported during the developmental period up to the age of five years among infants, toddlers and pre-school children, while late consequences occur after the age of five. Excessive exposure to digital media leads to a higher prevalence of being overweight and obese in the long term. The work of Goncalves, Byrne, Viana, & Trost (2019), conducted amongpreschool children, reportedthat excessive time spent in front of screens increases the risk of children being overweight or obese, reduces engagement in physical activity and increases consumption of unhealthy foods. The hypothesis put forward in this study concerns the association between screen time and children's weight. In the case of children aged 3-5 years, it was found that time spent in front of the screen was positively associated with the percentile of the child's body mass index; only the relationship between weekend screen time and BMI was statistically significant. This factor can be explained through another study showing that there is a higher incidence of unfavorable obesogenic behaviours on weekend days due to greater exposure to a less structured sedentary-oriented environment (Brazendale et al., 2017).

Screen Time and sleep

About 30% of pre-school children and between 50% and 90% of school-age children and adolescents do not get enough sleep. Excessive use of digital media is a likely contributor to sleep deprivation. Time spent in front of a screen is negatively associated with sleep health, as it causes a reduction in the number of hours of sleep at night and an increase in early insomnia. Potential factors underlying the observed relationships include: the effects of light emitted by devices which impairs sleep and impacts on wakefulness physiology, a greater number of hours being spent on screens than in sleeping at night and psychological stimulation based on media content (LeBurgeois et al., 2017). Healthy sleep patterns in childhood and adolescence are associated with a lower risk of obesity while short sleep duration is associated with obesity and weight gain during young adulthood (Hasler et al., 2004). According to a meta-analysis conducted by Cappuccio et al. (2008), seven of the 11studies collected, which covered subjects aged from 2 to 20 years, reported a significant association between short sleep duration and obesity. This research also suggests that a reduction of one hour of sleep per day would be associated with a 0.35 kg/m^2 increase in BMI. Few studies have investigated the association between screen time and sleep duration among young children. One such study (Chen, et al., 2019) was carried out on 714 Singaporean children aged 2 years and less. The data collected describe how in Japan, at 18 months, 86% of children spend more than one hour per day watching TV; in Australia, children under four years old spend on average more than two hours a day watching TV and, similarly, in the USA, 90% of children aged two years old make regular use of multimedia devices for an average duration of 90 minutes per day. The use of multimedia may directly limit the duration and continuity of sleep. There is evidence to support the hypothesis that increased screen time is associated with a degradation of sleep quality (duration, nocturnal awakenings, restless sleep). These data were collected through questionnaires given to parents with questions derived from the Children's Sleep Habit Questionnaire (CSHQ), a pediatric sleep screening tool. However, it is not only TV that has a negative influence on sleep: screen time also includes the use of touch screen devices such as smart phones and tablets. There is one focused study (Cheung, Bedford, Saez De Urabain, Karmiloff-Smith, & Smith, 2017) that investigated whether the frequency of touch screen device use is associated with sleep in infants and toddlers aged 6-36 months. This research was also based on parents filling in an online questionnaire; the final result showed that increased use of touch screens is associated with reduced nighttime sleep, increased daytime sleep and increased time to fall asleep. However, there was no significant association between touch screen use and the

frequency of nocturnal awakenings. Each additional hour of tablet use was associated with 15.6 minutes less total sleep (on average, 26.4 minutes less sleep at night and 10.8 minutes more sleep during the day).

Material and methods

For this preliminary research, a 32-question online questionnaire was prepared, addressed to parents of children aged 0-6 years. Where parents had several children, the parent was asked to complete one questionnaire per child. All questions, both those concerning the parents and those relating to the children, were filled in by the parent. The purpose of the data processing, and guarantees on the anonymity and confidentiality of information were provided. Questionnaires were collected during the period 7-21 May 2020. 125 questionnaires were analyzed. Of the 32 questions, nine investigated general topics about parents such as "who fills in the questionnaire", "age of mum and dad", "educational qualifications of mum and dad", "nationality of mum and dad", "profession of mum and dad";three questions asked for information about the child, such as gender, age, weight and height. The remainder of the questionnaire was divided into two parts: 12 questions concerning electronic devices and seven questions relating to sleep habits. 60% of the children taking part in the research were male (n=75), and 40% female (n=50).

Children in the 12-35 month age group represented 38% (n=47) of the survey sample. Children in the 36-59 month age group represented 33% (n=41). Children in the 60-83 month age group accounted for 24% (n=30). Children in the 0-11 month range accounted for 6% (n=7). Using the anthropometric data obtained from the questions on the children's weight, height and gender, it was possible to calculate the various BMIs and establish their percentiles, using the tables provided by the WHO (WHO, 2006). The guidelines state that a subject below the 5th percentile is considered underweight, a percentile between the 5th and 84this defined as being of normal weight, between the 85th and 94th percentiles corresponds to being overweight and, finally, from the 95th percentile upwards implies a condition of obesity. The different weight incidences were analyzed for the four established age groups (Figure1).Table 1 shows the anthropometric data.

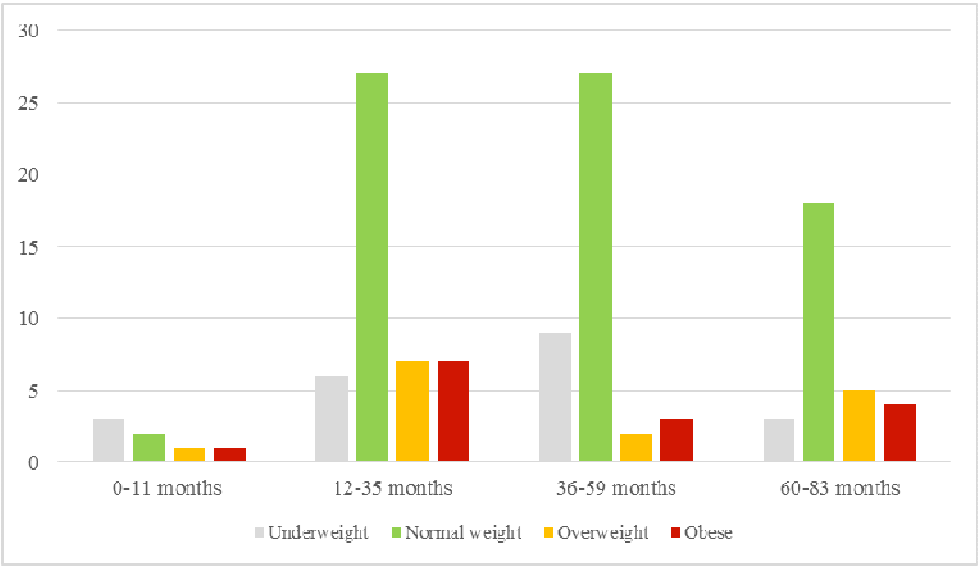

Figure 1. Weight status: participants by age

Table 1. Anthropometric data of all participants and by gender.

Gender	M	F	M+F
Participants	n=75	n=50	n=125
	Mean	**Mean**	**Mean**
Age (months)	39.6	40.9	40.1
Stature (cm)	99.0	99.0	98.2
BMI (kg/m^2)	15.7	15.4	15.6
Percentile for BMI	49.2°	40.9°	42.7°
Percentile for weight	58.6°	51.3°	55.6°

Screen time

In the second part of the questionnaire, 11questions were asked about children's use of electronic devices, covering both the period before and after the Covid-19 pandemic.

The first question investigated the number and range of electronic devices owned by each household. Smartphone's were found to be the most frequently owned devices. There were258 such devices in 125 households. Only one household had no Smartphone at all.

The second most common device was found to be the TV: 214 TVs were owned by the 125 households. Only two households reported that they did not have a TV in their home. The next most popular devices were laptops, with 148 across the125 households, and tablets, with 92 owned by the 125 households.

Considering all the children surveyed, it emerged that in the period before the health emergency, 48% were using smart phones and/or tablets. With the onset of the pandemic, this figure increased to 65% of those interviewed.

Results

Screen time and guidelines

The questionnaire included questions that investigated the extent of exposure to electronic devices and how people use them. The data analysis divided the subjects into four bands, so that they could be compared with existing WHO guidelines (WHO, 2019). The first question, concerning the duration of daily media exposure, concerned smart phones (If your son/daughter uses a Smartphone every day, how long does he/she use it for?). This was followed by two further questions with the same formula, but relating to tablets and televisions. Possible answers ranged from 'never' to 'more than two hours'.

This section of questions was used to define how Covid-19 may have influenced the children's lifestyles. Analysis of the responses showed that although 56% of the children (n=70) complied with the guidelines prior to the period of the health emergency, there was already a substantial proportion of 44% (n=55) who did not observe the WHO guidelines on recommended screen time. Furthermore, as illustrated in graph 4, when looking at the data for the current pandemic period, the percentage of children not following the guidelines increased to70% (n=87).

Sleep

The last section of the questionnaire consisted of seven questions dedicated to sleep habits, taken from the Questionnaire on Sleep Habits for Children and Adolescents (QASBA). Questions included the average hours of sleep before and during the lockdown. On average, the children were reported to sleep between 9 and 10 hours per night. For all age groups the average number of hours of sleep did not vary particularly, except for children in the 60-83 month range; this group slept on average almost one hour more per night during the lockdown period than during the pre-lockdown period (Table 2).

Table 2. Average hours of sleep by age group.

	Pre-lockdown	**During lockdown**
0-11 months	9.4	9.4
12-35 months	9.6	9.6
36-59 months	9.9	10
60-83 months	9	9.8

In the 0-11 months age group, only one in seven children was found to observe the suggested guidelines in both periods analyzed. 85.7% of children slept fewer hours than recommended. Even in the 12-35 month range most children did not meet the guidelines. During the pre-lockdown period, only 12.7% of the children slept for the recommended number of hours at night. With lockdown this figure rose to 23.4%. For children in the 36-59 month range, the results were the opposite: those whose sleep duration was within the guidelines predominated with 73% in the pre-lockdown period and 78% during the lockdown. The last age group, 60-83 months, was found to be the most observant of the guidelines.

The majority of children's sleep was within the guidelines both in the pre-lockdown period, with about 83%, and in the emergency period, when it increased to about 93%. Considering the survey sample as a whole, it can be observed that lockdown did not substantially affect the amount of time children sleep. During the lockdown period, the percentage of children whose sleep hours were within the hours prescribed by the guidelines increased to 57.6%. In some cases, the increase in sleep time during lockdown allowed the recommended hours of sleep to be achieved.

Analysis by age group reveals that in children in the 0-11 month age group the relationship between time spent in front of screens and BMI percentile is r=0.24; in the 12-35 month age group r=0.08; in the 36-59 month age group r=0.06; and from 60-83 months r=0.07. Considering all subjects in the study, the data listed above confirm that there is no correlation between screen time and BMI in children aged 0-6 years (r=0.09) (Figure 2).

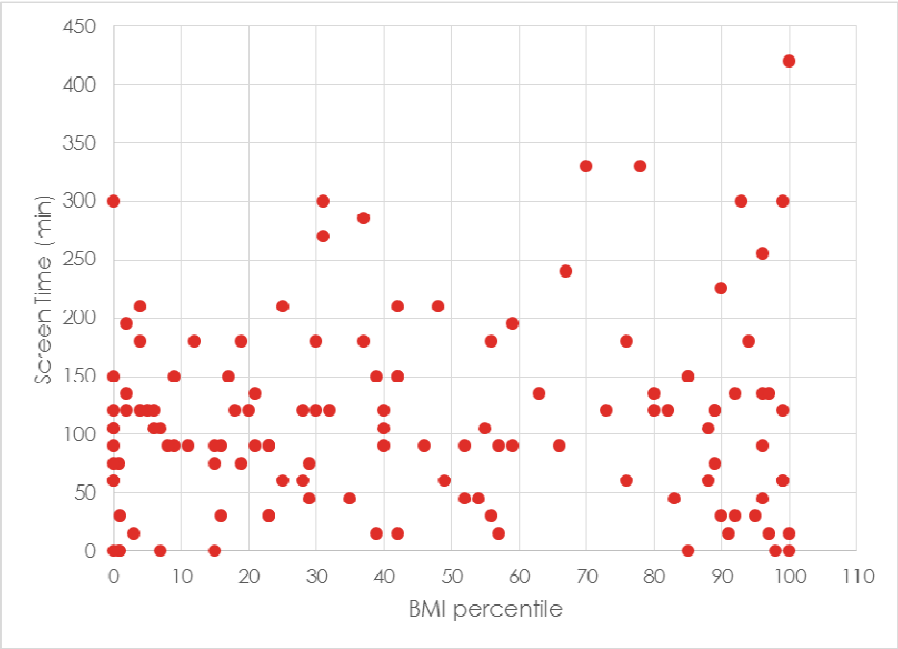

Figure 2. Relationship between screen time and BMI.

Considering all the subjects in the study, there also appears to be no relationship between screen time and hours of sleep (r=-0.03) (Figure 3).Categorized by age group: 0-11 months r=0.63; 12-35 months r=-0.34; 36-59 months r=0.06; 60-83 r=0.28.

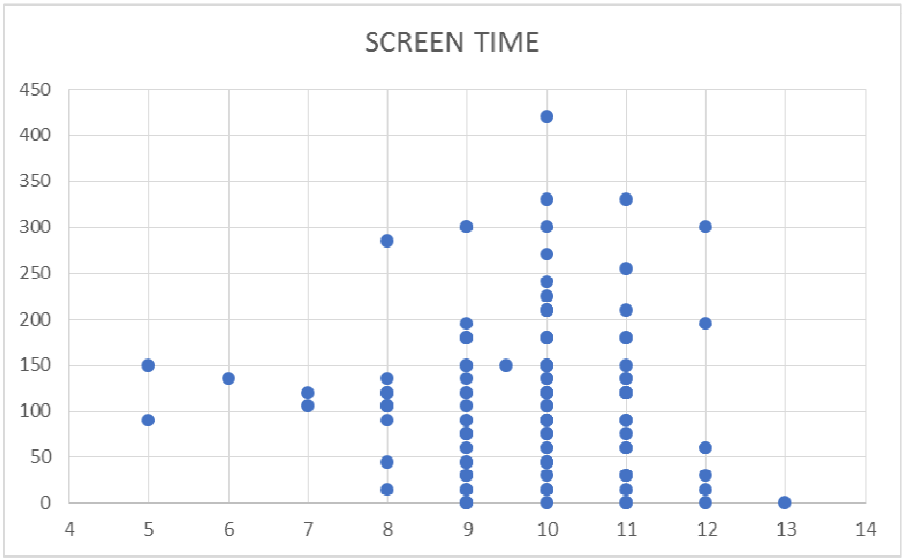

Figure3. Relationship between screen time (min) and sleep (hours)

Discussion

Several studies have attempted to examine the relationships between sleep and various health indicators, such as weight and sedentariness in childhood. The review by Chaput et al. (2017) included studies on healthy children aged between 1 and 59 months. The results on sedentary behaviour are mixed: out of five studies, four showed that shorter sleep duration was associated with longer screen exposure time. Only one study, however, showed that longer sleep duration at 4 years of age was associated with less TV viewing. Considering adherence to guidelines, Lee et al. (2017) examined data for 151 children, looking at hours of sleep, time of exposure to multimedia devices and physical activity, following the publication of the new Canadian 24-hour movement guidelines for early years (0-4 years).The results showed that only 11.9% of the children met the general guidelines. This result was influenced by screen time: 99.3% of the children met the recommendations on physical activity, 82.1% met the recommendations on sleep, but only 15.2% met the recommendations on screen exposure.98% (n=148 out of 151) of the children in Lee's study(2017) were aged between 12 and 23 months. In

this age range, the children in the current study were more likely to comply with the guidelines both prior to lockdown, at 55.3%, and during the health emergency, at 70%. Comparing the data on sleep time in the present study, the proportion of children observing the guidelines was substantially lower in both periods surveyed, as the recommended hours of sleep were not reached. The results on BMI compared with the Canadian guidelines are in line with the present study: no relationship was observed between the specific and general combinations of the guidelines and BMI. The relationships between sedentary behaviour (screen time) and obesity were unfavorable. A similar study conducted in Australia (Santos et al., 2017) reported results similar to those observed in the Canadian study: in a sample of 202 children, just under 9% met the general Australian guidelines. While most of the sample met the recommendations for physical activity (96.5%) and sleep (79.7%), only 11.4% met the guidelines on sedentary behaviour. Again, the issue of screen time significantly affected the percentage of subjects who managed to comply with the recommendations overall. The BMI scores also did not differ significantly between the children who did not meet any or all of the recommendations. Body mass index was not associated with the achievement of any of the guidelines.

Conclusion

The 2020 lockdown period experienced in Italy is an extreme example of a sedentary lifestyle. In this context, daily habits such as basic physical activity, routines, the rhythm of the day and a correct diet may be affected. However, the results of the present study do not seem to express any significant negative effects on the lifestyle of children in the 0-6 years age group who lived through the lockdown. Due to restrictions in Italy during the data collection period, the measurements of children's weight and height were carried out by their parents, as were estimates of their hours of exposure to technological devices and sleep. Assuming the existence of measurement errors in the anthropometric data and a distorted quantification of the hours declared by parents for both sleep and screen time, what emerged from the analysis of the data collected does not differ from the results found in the literature.

In view of the results of the analysis of the relationships between screen time-sleep and screen time-BMI, it can be stated that, for the 0-6 years age group, compliance with the WHO guidelines does not significantly affect the indicators investigated. Although no relationships were found with sleep and body mass index, this does not mean that screen time does not affect other important indicators such as cognitive, motor and language development. The lockdown and the population's response to it seem far removed from the health promotion perspectives issued by the WHO. Children, like adults, are faced with radical changes in their lives, such as being confined to the home, being prevented from exercising outdoors, not having peers to socialize with, and living with parents who are mostly unable, for various reasons, to care for and promote their children's PA. It is extremely important for students to get as much physical activity needed (Praphul et al., 2016). Educators, as well as parents should incorporate physical activity levels for students during and after school hours to replace screen-time (Raiola, 2012; Cereda, 2016).In order to deal with the social emergency of sedentary lifestyles, the lack of fair play and the early abandonment of physical activity and sport, a new path of continuity between the family, the school and the world of sport must be outlined (Cereda, 2017).However, considering the results of this original study show that the period of social distancing allowed several children to improve their sleeping habits. While before the pandemic 49.6% of children did not reach the standards set out in the sleep guidelines, during the first Covid-19 lockdown this figure improved slightly to 57.6%. It can therefore be said that two months of social distancing did not cause significant short-term damage to sleep patterns and weight status in the subjects studied. The results from both this study and the existing literature are inconclusive. Therefore, it is not possible to state that high exposure to multimedia devices is harmful in terms of sleep quality and BMI changes. The high percentage of children with habits different from those suggested by the guidelines, both concerning sleep and screen time, suggests that there is a need to increase parents' awareness and knowledge of the WHO recommendations. Finally, modifying parents' own habits in relation to the use of TV and other multimedia devices could positively influence the sedentary behaviour (screen time) of their children as well. The example of a healthy and active lifestyle provided by the parent, an indispensable figure in the development of every child, would therefore be the most important educational tool. A positive example would be an increase in self-efficacy in learning a healthier routine and, at the same time, a decrease in children’s desire to remain virtually connected to tablets, smart phones and computers, on account of their being attracted to play activities that are certainly more stimulating for their growth.

Author contributions

F.C.: Conceptualization, Methodology, Data curation, Writing-Review & Editing, and Supervision.
E.V.: Conceptualization, Investigation, Formal Analysis, Writing-Original Draft Preparation.

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