

# Screen-based sedentary behaviours in geographic areas with different levels of childhood overweight and obesity: the Italian ZOOM8 study

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## ABSTRACT

**BACKGROUND:** Screen-based sedentary behaviours (SbSB) likely have a negative impact on many aspects of youth health and development. The purpose of this study was to describe the SbSB and to examine the associated factors in a sample of Italian school children.

**METHODS:** 2129 children, aged 8-9 years, from the three geographical areas of Italy with different levels of childhood overweight/obesity were involved. Body weight and height were measured. SbSB were evaluated using a parent-reported questionnaire with items about the time spent watching television (TV) and using computer/playstation/other electronic games. Pearson's chi-square test and logistic regression analysis were conducted to study possible associated factors.

**RESULTS:** More time was spent in SbSB during non-school days than on school days. More males than females watched television exceeding the recommended 2 hours/day and spent the same time using computer/playstation/other electronic games. The presence of a TV in the child's bedroom was significantly associated with geographical area, and inversely associated with maternal education level. Moreover, children with a TV in the bedroom had higher odds of being overweight/obese (OR=1.36; 95% CI 1.07-1.73) and watching TV for more than 2 hours/day (OR=1.53; 95% CI 1.14-2.04 on weekdays; OR=1.30; 95% CI 1.04-1.62 on weekends) than those without a TV. Child's gender, mother's age and education were predictors of the SbSB.

**CONCLUSIONS:** Children from the studied Italian regions spent a considerable amount of time in SbSB, exceeding media recommendations, especially in the Southern area. Policies should be tailored geographically and especially aimed at caretakers to enforce rules regarding SbSB.

*Key words:* Children, sedentary behaviour, screen time, TV viewing

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## INTRODUCTION

In recent years, dramatic environmental and society changes along with technological advances have created sedentary lifestyles which are characterized by having less opportunities for being physically active, and more ones for being inactive. As a result, children and adolescents spend a significant amount of time engaging in sedentary behaviours [1].

Early childhood has been identified as a critical time in the development of sedentary behaviours and many studies show that these behaviours track strongly into childhood and adolescence [2,3]. **Sedentary behaviour is defined as any waking behaviour characterized by an energy expenditure  $\leq 1.5$  METs while in a sitting or reclining posture** [4]. It is becoming increasingly clear that it is the total time spent in sedentary behaviour, and the length and number of the bouts spent being sedentary, that are important risk factors for health in adolescents [5,6]. Previous studies have shown that increased sedentary behaviours, such as television viewing, video game playing, computer game playing, and/or electronic game playing, are linked to increased risk for overweight and obesity in the child population [7-10]. It has been observed that as the number of daily hours of exposure to TV increases consequently the time that children spend in physical activities decreases. To explain this phenomenon, some authors spoke about an hypnotic effect of the TV that would cause the children to stay glued to the screen with the consequence of a marked reduction of time spent in physically active pastimes and the occurrence of overweight and obesity [11]. In addition, children who had a television in their bedroom spent more time in screen-based sedentary behaviour [12-15]. With the aim of reducing the screen-time among children and adolescents, international guidelines recommend that youth should not spend more than 2 hours/day on TV, videogames, computer, internet viewing [16]. Unfortunately, despite knowledge on the physiologic differences between activity and sedentary behaviour and increasing interest in the physiologic medical, and public health effects of too much sedentary time [17], few studies have examined the independent effect of overall sedentary time, screen time, and increased non exercise activity (ie. light activity)

on adiposity [18]. In addition, it is fundamental also to study characteristics such as parental weight and socio-economic status, known to be associated with child sedentary behaviour [19,20], that may modify the relationship of identified correlates with sedentary behaviour [21]. In Italy, the national school children survey "OKkio alla SALUTE 2008", reported a high prevalence of overweight/obesity in 8-9-year-old children, with higher values in the South [22,23] and lower ones in the North. Their rate of physical activity was low, about half of the children had a TV in the bedroom and watched it for 3 or more hours a day [22]. Also more recent Italian studies on the prevalence of overweight and obesity in children 6-11 years confirmed the same North-South trend [24]. In order to improve public health interventions, the ZOOM8 study, examined the Screen - based sedentary behaviour (SbSB) of the Italian children living in the three geographic areas with different levels of childhood overweight and obesity.

Main results are presented in this paper which aims to: describe SbSB by gender, geographical area and ponderal status; determine the relationship between electronic media availability in children's bedroom and the risk for excessive TV viewing (>2 hours/day) and the risk for being overweight; explore possible determinants of excessive sedentary screen time.

## METHODS

### Study design

The ZOOM8 study was a nation-wide cross-sectional investigation, part of the project "System of surveys of behavioural risks in ages 6-17", promoted by the Ministry of Health/National Centre for Disease Prevention and Control, aimed at finding the modifiable risk factors, including all the aspects of feeding behaviour, physical activity, sedentary behaviour, family and environmental agents, associated with overweight and obesity in Italian primary school children, with the purpose of providing data for designing targeted interventions [22].

The study was performed on a sample of children aged 8-9 years attending the third grade of public and private primary schools.

The selection of the sample was done at the regional level, using a list of schools and classes provided by regional school authorities and classifying Italian regions in three areas of low (North Italy), medium (Centre) and high (South) prevalence of overweight and obesity, on the basis of the results of the “OKkio alla SALUTE 2008” survey [22,23,25]. Two regions for each area were explored: Friuli Venezia Giulia and Liguria in the North, Marche and Lazio in the Centre and Calabria and Sicily in the South. Cluster sampling was carried out according to World Health Organization (WHO) cluster survey methodology [26] with classes as the unit of sampling. The number of children to be surveyed in each geographical area was calculated based on an expected prevalence rate of overweight and obesity of 30%, a desired precision level using 95% confidence intervals of 5%, and a design effect of 2. The resulting number was increased of 11.5% in order to compensate for possible refusals to participate to the study. Thus, 720 children per each area were considered corresponding to an estimate of 40 classes, assuming an average of 18 children per class. 127 third grade classes were recruited for a total of 2565 children enrolled. Given the important amount of collaboration needed from families and teachers, the participation rate to the study was high (92,3%) and only one class refused, however 6.4% of the total children ( $n=164$ ) were absent from school the day of the survey and it was not possible to recover them afterwards.

Overall, 2193 children with complete and valid anthropometry measurements (1117 males) were investigated in the study, and 2129 of them with complete and valid questionnaire were included in the analysis relative to this paper.

Data collection was performed in April-May 2009. The study was in compliance with the Ethical Committee of the Italian National Institute of Health. Only children with a consent form signed by a parent or legal guardian were included in the sample.

### Anthropometric measurements

To classify children on the basis of their ponderal status, height and weight were measured by trained and standardized staff of the local health units, according to WHO

[27]. Height was measured to the nearest 0.1 cm by stadiometers SECA 214 (Hamburg, Germany). Weight was measured to the nearest 50 g by electronic scales SECA 872™ (Hamburg, Germany). According to the surveillance system “OKkio alla SALUTE” protocol, a validated, simplified procedure was used [28,29], in order to encourage children and their parents to join in the study: body weight was measured with clothes, rather than in light underwear (removing shoes, jackets, heavy sweaters, belts and emptying the pockets) and then corrected for the estimated weight of the clothing.

Body Mass Index (BMI) was calculated as the weight divided by the square of the height ( $\text{kg}/\text{m}^2$ ). Ponderal status was assessed by gender-age specific BMI reference values of Cole & Lobstein [30].

### Questionnaire

A self-administered questionnaire was completed by the parents. The description of the SbSB included time spent viewing television and that spent using computer/playstation/other electronic games on school days and non-school days separately, with the following response categories: never, less than 1 hour/day, 1 to less than 2 hours/day; from 2 to less than 3 hours/day; 3 or more hours/day (for data analyses the participants were thereafter classified into three groups for each screen-based sedentary behaviour: less than 1 hour/day; between 1 and 2 hours/day; more than 2 hours/day) and if children had a television and a computer in the bedroom (yes/no). The questionnaire also included information on the child’s family (age and reported weight and height of parents, parental education level, occupation and physical activity).

### Statistical analysis

Statistical analyses were performed using the statistical packages Statistica for windows version 8.0 (StatSoft, Inc., Tulsa, OK, USA) and SAS, version 9.2 (User’s Guide. Cary, NC, USA: SAS Institute Inc, 2008) for logistic regression. All analyses took into account the sampling design. The class identification code identified the first-stage (primary) sampling units, or clusters. Geographical areas and regions determined

the strata from which classes were selected. A sampling weight was assigned to children enrolled in each stratum, computed as the reciprocal of the selection probability (ratio of the resident population aged 8-9 years to the number of children selected in each stratum). Continuous variables are presented as mean values with their standard errors (SE), while categorical variables are presented as relative frequencies. Associations between categorical variables were tested by contingency tables and Pearson's chi-square test. A multiple logistic regression model was employed to study the associations between children's spending >2 hours/day in SbSB (response variable) and potential determinants like mother's and father's age, mother's and father's ponderal status, parental education and physical activity; gender and geographical area were confounding factors. Three multiple logistic regression models were also estimated separately for the three geographical areas. A simple entry procedure was employed for the explanatory variables. The likelihood-ratio test and the efficiency Score test were used for testing the goodness of fit, these tests resulting significant for the considered models. Wald chi-square test was used for testing the significance of individual parameters. For all the tests a p-value <0.05 was considered to be statistically significant.

## RESULTS

The characteristics of the study sample are shown in Table 1. Time spent in SbSB according to gender, ponderal status and geographical area is presented in Table 2. The percentage of children that spent >2 hours/day watching television during non-school days was higher compared to school days. Moreover, the percentage of children that used PC/playstation/other electronic games for >2 hours/day was greater on non-school days rather than school days. The rate of males that watched TV and/or played computer/video games for >2 hours/day during both school days and non-school days, was significantly greater ( $p = 0.003$  and  $p = 0.042$  for TV during school days and non-school days respectively and  $p < 0.0001$  for PC/playstation/other electronic games) than that of females. The percentage of children who watched TV for >2 hours /day was higher in the overweight/obese group rather than in the

under/normalweight one, on both schooldays ( $p = 0.0007$ ) and non-school days but in this case the difference was not significant ( $p = 0.079$ ).

On school days just over half of the children investigated spent between 1-2 hours viewing TV, without significant differences by geographical area. When considering the proportion of children who watched TV for <1 hour/day and that of those who watched TV for >2 hours/day, significant differences ( $p = 0.002$ ) were observed between the North and the South: children who spent <1 hour/day were 38.0% in the North and 25.8% in the South, conversely children who watched television for >2 hours/day were almost double in the South (21.1%) compared to those in the North (11.7%). The same geographical trend and significance ( $p = 0.015$ ) were observed during non-school days. Generally, children spent less time in using a computer/play-station/other electronic games than in viewing TV, but the geographical trends were very similar.

50.8% of children had a TV and 31.5% had a computer in their bedroom (Table 3). Higher percentages of children with TV or PC in the bedroom were observed among those using these devices for >2 hours/day, both on school days and non-school days. Having a TV in the bedroom was associated with geographical area (higher percentages were reported in the Centre and in the South rather than in the North,  $p = 0.002$ ), with child's ponderal status (55.7% in the overweight/obese group vs. 48.0% in the under/normalweight one,  $p = 0.011$ ) and strongly inversely associated with the mother's education level. In the same way, the percentages of children with a PC in the bedroom increased with decreasing mother's education level.

Crude odds ratios of being overweight/obese, of watching TV and of using PC for >2 hours/day were calculated for those having TV and those with a PC in the bedroom. Children having a TV in the bedroom were 36% more likely to be overweight/obese, were 53% and 30% more likely to watch TV for >2 hours/day during schooldays, and non-school days respectively, than those without a TV in their bedroom. Compared to children without a PC in the bedroom, those who had it were over 2 times more likely to use it for >2 hours/day during schooldays, and 67% more likely to use it during non-school days.

Table 4 presents results of logistic regression

TABLE 1

PHYSICAL CHARACTERISTICS OF THE SAMPLE (MEAN $\pm$ SE).					
	N	AGE (YEARS)	WEIGHT (KG)	HEIGHT (CM)	BMI (KG/M <sup>2</sup> )
<b>GENDER</b>					
Males	1084	8.8 $\pm$ 0.04	33.0 $\pm$ 0.29	133.5 $\pm$ 0.26	18.3 $\pm$ 0.13
Females	1045	8.8 $\pm$ 0.03	32.8 $\pm$ 0.36	133.5 $\pm$ 0.33	18.3 $\pm$ 0.16
<b>GEOGRAPHICAL AREA</b>					
North	730	8.9 $\pm$ 0.02	32.4 $\pm$ 0.22	134.5 $\pm$ 0.30	17.8 $\pm$ 0.11
Centre	673	8.8 $\pm$ 0.05	32.8 $\pm$ 0.38	133.6 $\pm$ 0.31	18.2 $\pm$ 0.16
South	726	8.8 $\pm$ 0.07	33.1 $\pm$ 0.44	133.0 $\pm$ 0.46	18.5 $\pm$ 0.21
<b>PONDERAL STATUS</b>					
Under/normalweight	1384	8.8 $\pm$ 0.04	28.5 $\pm$ 0.16	132.1 $\pm$ 0.26	16.2 $\pm$ 0.06
Overweight	520	8.8 $\pm$ 0.04	37.5 $\pm$ 0.25	135.2 $\pm$ 0.39	20.4 $\pm$ 0.06
Obese	225	8.7 $\pm$ 0.05	47.2 $\pm$ 0.61	137.0 $\pm$ 0.60	25.0 $\pm$ 0.20
Total sample	2129	8.8 $\pm$ 0.04	32.9 $\pm$ 0.26	133.5 $\pm$ 0.25	18.3 $\pm$ 0.12
<b>PONDERAL STATUS</b>	<b>N</b>	<b>FREQUENCY %</b>		<b>IC</b>	
Under/normalweight	1384	63.6		60.9 - 66.4	
Overweight	520	24.6		22.7 - 26.4	
Obese	225	11.8		9.9 - 13.8	

analyses. From the model referred to the total sample, children living in the Centre and South of Italy were 48% and 63% respectively more likely to spend >2 hours/day in SbSB, than children living in the North; females were 43% less likely to be engaged in such activities. In the Northern regions females were about 30% less likely to be engaged in SbSB for >2 hours/day than males, while in the other geographical areas females were over 40% less likely to be engaged in such activities. Only in the North, children with mother aged 35-44 years resulted almost 30% less likely to be engaged in SbSB for more than 2 hours/day than those with  $\geq$ 45 years mother, and children with at least one parent with university degree resulted 54% less likely to spend time in SbSB.

## DISCUSSION

Watching television, playing video games, using computers are the most frequent sedentary lifestyle patterns of the contemporary young people and are frequently associated with

the increasing prevalence of overweight and obesity in childhood [31,32]. The aim of this study was to examine the SbSB and associated factors of a sample of Italian school children. It was found that a high percentage of children exceeded the 2 hours recommendation and, so much as half of them, were exceeding 2 hours per day on non-school days. Children doing so, were more overweight/obese, more males than females and living more in the South of Italy than in the North. The results of this study are similar to those reported in the National Health and Nutrition Examination Survey (NHANES) 2001-2006, i.e. a large percentage of the children in the United States are exceeding 2 hours per day of sedentary behaviour, with large amounts of TV/videos. Further, it appears there are gender, ethnic, age, BMI, and household income differences in the amount of time spent in sedentary behaviour (i.e., total screen time) [33]. Also other studies carried out in Europe showed that children spent more time watching television and playing video games on weekends than on weekdays and boys more time in both cases than girls [34,35].



TABLE 2

PERCENTAGES OF CHILDREN ACCORDING TO SBSB BY GENDER, GEOGRAPHICAL AREA AND PONDERAL STATUS												
	TIME OF TV VIEWING ON SCHOOL DAYS (ROW%)			TIME OF TV VIEWING ON NON-SCHOOL DAYS (ROW%)			TIME USING COMPUTER/PLAY-STATION/OTHER ELECTRONIC GAMES ON SCHOOL DAYS (ROW%)			TIME USING COMPUTER/PLAY-STATION/OTHER ELECTRONIC GAMES ON NON-SCHOOL DAYS (ROW%)		
	< 1 HOUR	1-2 HOURS	> 2 HOURS	< 1 HOUR	1-2 HOURS	> 2 HOURS	< 1 HOUR	1-2 HOURS	> 2 HOURS	< 1 HOUR	1-2 HOURS	> 2 HOURS
<b>GENDER</b>												
Males	25.9	51.7	22.4	13.2	40.0	46.8	70.2	23.6	6.2	42.8	40.4	16.8
Females	32.1	51.9	16.0	14.9	45.0	40.1	86.2	11.6	2.2	67.0	28.0	5.0
p-value	0.003			0.042			<0.0001			<0.0001		
<b>GEOGRAPHICAL AREA</b>												
North	38.0	50.3	11.7	20.6	44.5	34.9	86.0	12.1	1.9	63.6	29.6	6.8
Centre	29.3	51.1	19.6	13.3	42.4	44.3	78.1	18.2	3.7	53.6	34.6	11.8
South	25.8	53.1	21.1	12.7	41.9	45.4	76.0	18.6	5.4	53.6	35.3	11.1
p-value	0.002			0.015			0.009			0.048		
<b>PONDERAL STATUS</b>												
Under/normalweight	32.1	50.5	17.4	14.6	44.2	41.2	79.3	16.5	4.2	54.9	34.3	10.7
Overweight/obese	23.4	54.2	22.4	13.1	39.5	47.4	76.5	19.3	4.2	55.2	33.8	11.0
p-value	0.0007			0.079			0.410			0.974		
Total	29.0	51.8	19.2	14.1	42.5	43.4	78.3	17.5	4.2	55.0	34.2	10.8

In addition, in the San Diego Study of Child Activity and Nutrition, a higher maternal education was also associated with lower TV viewing duration in children, but this result was only statistically significant in early childhood (6 years) and in a large Australian sample, maternal education was strongly inversely related to daily TV viewing in both, younger children (mean age 6 years) and older children (mean age 11 years) [36]. Similar results were observed in this survey.

Different studies have suggested that the home environment, and in particular the presence of a TV set in a child's bedroom, influences children's TV watching [37]. This study showed that having a TV set in the bedroom was associated with an increased risk of being overweight/obese and watching TV for >2 hours/day. Similar findings have been reported in many previous studies that suggested that children with a television in their bedroom watch more TV and have fewer rules about television than children without a television in their bedroom [19,38-41].

Finally, the multiple logistic regression showed that gender is a predictor of the time spent on screen-based sedentary activity. Other predictors are the mother's age and parental level of education, but only for the subsample of children living in the North of Italy.

The strengths of these analyses include a large, fairly representative sample of an under researched European population and the public health implication of these SBSB. Moreover, the rate of retention in this study was high. Furthermore, the study takes into account the three geographical areas of Italy with different prevalence of overweight and obesity. An important limitation is the cross-sectional survey, thus, the direction of these findings cannot be determined. Another limit of this study is the use of gender-age specific BMI reference values to define the ponderal status of children, due to the need for reliable measures and high acceptance by children and families. In fact BMI, currently reckoned as a valid indirect measure of adiposity in children for survey purposes, being associated with body

TABLE 3

FACTORS ASSOCIATED WITH HAVING A TV AND A PC IN CHILD'S BEDROOM.						
	HAVING A TV IN BEDROOM (ROW %)			HAVING A PC IN BEDROOM (ROW %)		
	YES	NO	P-VALUE	YES	NO	P-VALUE
	50.8	49.2		31.5	68.5	
<b>GENDER</b>						
Males	51.4	48.6	0.582	33.5	66.5	0.095
Females	50.2	49.8		29.4	70.6	
<b>GEOGRAPHICAL AREA</b>						
North	36.8	63.2	0.002	27.9	72.1	0.404
Centre	55.8	44.2		31.0	69.0	
South	50.7	49.3		33.1	66.9	
<b>CHILD'S PONDERAL STATUS</b>						
Normalweight	48.0	52.0	0.011	30.1	69.9	0.137
Overweight/obese	55.7	44.3		33.9	66.1	
<b>MOTHER'S EDUCATION</b>						
Less than high school	58.2	41.8	<.0001	34.8	65.2	0.0005
High school	51.8	48.2		33.1	66.9	
University	32.9	67.1		19.9	80.1	
<b>HOURS WATCHING TV / SCHOOLDAYS</b>						
≤ 2 hours/day	48.9	51.1	0.003	-	-	
> 2 hours/day	59.4	40.6		-	-	
<b>HOURS WATCHING TV/NON-SCHOOL DAYS</b>						
≤ 2 hours/day	48.1	51.9	0.020	-	-	
> 2 hours/day	54.5	45.4		-	-	
<b>HOURS USING PC / SCHOOLDAYS</b>						
≤ 2 hours/day	-	-		30.8	69.2	0.005
> 2 hours/day	-	-		49.0	51.0	
<b>HOURS USING PC/NON-SCHOOL DAYS</b>						
≤ 2 hours/day	-	-		30.2	69.8	0.001
> 2 hours/day	-	-		42.0	58.0	
	<b>ODDS RATIO (95% CI)</b>					
	<b>HAVING A TV IN BEDROOM (VS. NO)</b>			<b>HAVING A PC IN BEDROOM (VS. NO)</b>		
OR of being overweight/obese	1.36 (1.07 – 1.73)			1.19 (0.95 – 1.51)		
OR of watching TV > 2 hours/day on school days	1.53 (1.14 – 2.05)			-		
OR of watching TV > 2 hours/day on non-school days	1.30 (1.04 -1.62)			-		
OR of using PC > 2 hours/day on school days	-			2.16 (1.30 – 3.56)		
OR of using PC > 2 hours/day on non-school days	-			1.67 (1.24 – 2.25)		

TABLE 4

ODDS RATIOS AND 95% CIs, FOR TOTAL SAMPLE AND GEOGRAPHICAL AREAS, CONTRASTING CHILDREN WITH >2 HOURS A DAY OF TOTAL SCREEN TIME WITH OTHERS BY THE INDICATED VARIABLES <sup>a</sup>				
	TOTAL SAMPLE	NORTH	CENTRE	SOUTH
<b>GEOGRAPHICAL AREA</b>				
North	Referent group	-	-	-
Centre	1.48** (1.14-1.91)	-	-	-
South	1.63* (1.28-2.07)	-	-	-
<b>GENDER</b>				
Males	Referent group	Referent group	Referent group	Referent group
Females	0.57** (0.45-0.72)	0.68* (0.46-0.99)	0.59* (0.38-0.91)	0.54* (0.38-0.77)
<b>MOTHER'S AGE</b>				
20-34	1.15 (0.69-1.89)	0.76 (0.42-1.40)	1.22 (0.36-4.12)	1.24 (0.62-2.48)
35-44	0.81 (0.56-1.18)	0.62* (0.41-0.93)	0.78 (0.30-2.10)	0.88 (0.53-1.45)
45-54	Referent group	Referent group	Referent group	Referent group
<b>FATHER'S AGE</b>				
20-34	0.67 (0.35-1.32)	1.40 (0.58-3.33)	0.87 (.24-3.15)	0.56 (0.22-1.46)
35-44	1.07 (0.78-1.48)	0.88 (0.62-1.24)	1.07 (0.54-2.13)	1.18 (0.73-1.90)
≥45	Referent group	Referent group	Referent group	Referent group
<b>PARENTAL EDUCATION<sup>b</sup></b>				
Less than high school	Referent group	Referent group	Referent group	Referent group
High school	1.04 (0.83-1.31)	1.04 (0.74-1.49)	0.67 (0.37-1.21)	1.12 (0.83-1.51)
University	0.77 (0.55-1.09)	0.46* (0.31-0.69)	0.55 (0.27-1.11)	0.94 (0.56-1.59)
<b>MOTHER'S PONDERAL STATUS</b>				
Under/normalweight	1.07 (0.57-2.01)	0.94 (0.45-1.99)	0.60 (0.20-1.82)	1.19 (0.50-2.84)
Overweight	1.19 (0.64-2.21)	0.73 (0.34-1.54)	0.97 (0.20-2.92)	1.45 (0.61-3.46)
Obese	Referent group	Referent group	Referent group	Referent group
<b>FATHER'S PONDERAL STATUS</b>				
Under/normalweight	0.99 (0.68-1.46)	0.86 (0.46-1.62)	0.72 (0.28-1.79)	1.12 (0.68-1.85)
Overweight	1.03 (0.73-1.46)	0.91 (0.46-1.78)	0.78 (0.35-1.75)	1.11 (0.71-1.75)
Obese	Referent group	Referent group	Referent group	Referent group
<b>PARENTAL PHYSICAL ACTIVITY</b>				
None physically active	1.09 (0.79-1.50)	1.39 (0.91-2.13)	1.22 (0.74-2.00)	0.75 (0.40-1.43)
One parent physically active	1.23 (0.86-1.74)	1.43 (0.69-1.90)	1.60 (0.96-2.67)	0.89 (0.43-1.82)
Both physically active	Referent group	Referent group	Referent group	Referent group

<sup>a</sup>Variables are mutually adjusted

<sup>b</sup>Higher Educational level between father and mother

\* p-value<0.05, \*\* p-value<0.005

composition and risk factors [42,43] and practical for comparisons between population groups or monitoring a population, has several limits and its variations can reflect changes in lean rather

than fatmass or internal rather than peripheral fat, implicating various health risks [42].

Also, parental report of children's sedentary behaviour is less accurate than direct



observation [44]. Despite these limits, the data presented in this paper demonstrate that a high percentage of Italian school children spent a considerable amount of time in SbsB, more than currently recommended, especially in the South. It is also noteworthy that the international study Health Behaviour in School-aged Children (HBSC), carried out on 11, 13 and 15 years old adolescents in the same period, suggests the existence of a trend to the increase of the sedentary behaviours with the increase of age. In fact, the HBSC study showed, respect to the younger children investigated in the ZOOM8 study, a higher percentage of Italian teenagers that spend more than two hours per day watching TV and using computer/playstation/similar devices and especially that this percentage increases with increasing age, as the amount of adolescents that never practice physical activity [45].

## CONCLUSIONS

Children from the studied Italian regions spent a considerable amount of time in SbsB, exceeding media recommendations, especially in the Southern area. Thus, SbsB should be monitored from childhood, implementing, at the same time, effective intervention strategies tailored geographically and especially aimed at parents and other caretakers to enforce rules regarding television and other screen-based media.

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