

Health hazard of the increased widespread use of new technologies by children and young people in northern Italy

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Objectives This study analyzed the relationship children have with technological devices and took into account the physical, psychological and behavioral effects of the excessive use of new technology in comparison with the short amount of time spent in practicing sports.

Methods Altogether 585 students completed a questionnaire on the use of video display terminals (VDT), television (TV) sets and playstations, and on their health, following the use of such devices. A subsample completed a questionnaire on sports activities.

Results The main result was that the total average time spent in front of a playstation, VDT, and TV was very high, and a large percentage of children complain of eyestrain or musculoskeletal disorders after the use of VDT or playstations. In addition, most of the young people surveyed tended to practice very little sport.

Conclusions The authors concluded that it is very important to pay more attention to the quality of children's leisure-time activities in order to stimulate active and healthy lifestyles.

Key terms developmental age; sedentary lifestyle; sport; technological device.

The use of computers, an integral part of the modern way of life, is starting to involve children of younger ages. Often it is associated with an intense use of game consoles and hours and hours spent in front of a television set.

It is well known that technology represents a good source of information and knowledge and that, through television (TV) and the Internet, people can have a wide window to the world. Furthermore, computers and video games can help to develop particular abilities, such as reaction time, rapidity, and curiosity. Nevertheless, its extensive, indiscriminate, and uncontrolled use can have serious negative consequences, especially on children (1). Eyestrain and incorrect habitual posture can cause the occurrence of physical problems to the eyes and the musculoskeletal system that can have damaging cumulative effects (2).

A consequence of the fact that children are spending increasing amounts of time in front of TV sets, computers, or video-game consoles, at an earlier age, is an

increasing sedentary lifestyle and a subsequent increasing percentage of overweight and obese children. This phenomenon is rapidly spreading among the youngest age groups in most of the developed countries (3, 4), and it seems to be related to the fact that most of these children never walk or cycle to school, spend very little time exercising, seldom play outside, and often, while watching TV and using computers, tend to consume snacks and sweet drinks in addition to their normal meals. Obese children are at risk of many serious physical, emotional, and social consequences that some years ago were considered to affect only adults.

Our study is part of wider research into children of developmental age, undertaken to analyze the relationship between anthropometric data, nutritional habits, leisure-time activities, and health hazards. The aim of this study was to analyze how children and young people use their free time with a specific focus on the amount of time spent with technological devices and the practice of structured and unstructured sports.

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Study population and methods

We analyzed data from a sample of 585 students, 278 from an elementary school (133 boys and 145 girls, aged 6.6–11.5 years) and 307 from a middle school (151 boys and 156 girls, aged 11.6–14.5 years), in the province of Turin (northern Italy).

The students were surveyed for a set of anthropometric variables and given a questionnaire on the use of video display terminals (VDT), TV, and playstations at home, on the dimensional features of their workstation, and on their health following the use of such devices. The health aspects were investigated through specific questions and graphic representations of the most relevant body segments to determine the presence of discomfort and pain in different anatomical areas.

We also submitted a questionnaire on sports activities to a subsample of children of the elementary school comprising 167 students of the second (7.6–8.5 years old) and the fifth (10.6–11.5 years old) grade, while, for the middle school, we submitted the questionnaire to the whole sample.

The questionnaire on sports activities was devised to survey structured sports (except sports activity at school) (ie, sports currently practiced with a trainer), free time sports currently practiced without a trainer, and sports played in the past. The children listed the different practiced sports in response to open questions.

As younger children cannot measure time precisely, we suggested that they ask their parents' help with filling out the questionnaire at home.

The data concerning sports practice (minimum 1 hour) were collected for the last school year and were analyzed in terms of frequency.

The data on the anthropometric variables and workstation dimensions have been published in other works (5–7).

Results

The first result was obtained from the assessment of the availability of technological devices at home, in the families. Altogether 83% of the boys and 74% of the girls in elementary school had a computer, while the percentages for those in middle school grew to 85% for the boys and 89% for the girls. We can, therefore, assume that both genders have substantially similar percentages of personal computer (PC) ownership. However, many of the students that had a PC at home did not use it (table 1), and this lack of use was more evident for the children of elementary school age (23% of the boys and 32% of the girls), while, for those in middle school, the percentages were 19% for the boys and 14% for the girls.

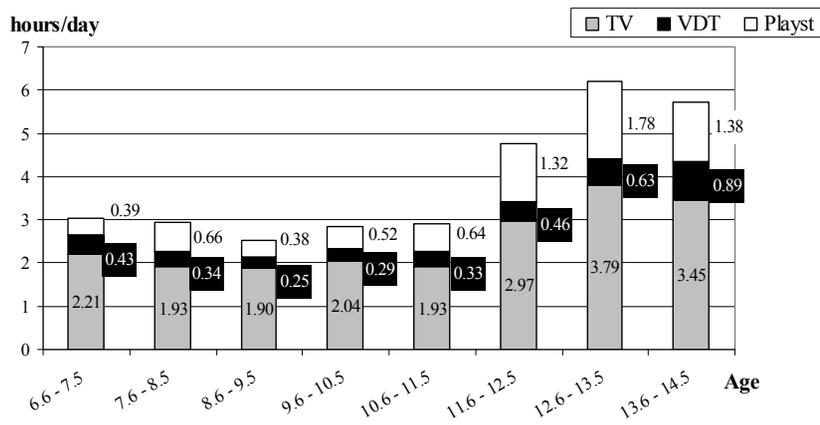
Playstation ownership was high among the boys of all ages (82% in elementary school and 87% in middle school), while, for the girls, it was significantly lower (42% in elementary school and 59% in middle school). Figure 1 presents the average time per day spent by the children at home in front of a computer monitor, TV screen, or playstation. In middle school, the total time was particularly high, primarily for the boys (as they spent much more time using playstations), the average time varying between 4.75 and 6.19 hours/day, but was high even for the girls (4.70–5.70 hours/day). The peak for both genders occurred in the 12.6- to 13.5-year age group and not in the 13.6- to 14.5-year age group, probably because, in the last class of middle school, students have to study more for final exams.

About one-third of the youngsters (on the average, 25% of the boys and 31% of the girls) complained of oculo-visual or musculoskeletal disorders after having used a VDT. These figures are worrying, especially when one considers the relatively short time spent in front of a VDT, as shown in figure 1; it

Table 1. Percentage of children not using and using personal computers (PC) for studying or playing (data refer to home use during the last school year).

PC use	Elementary school					Middle school				
	Age group (years)					Total (%)	Age group (years)			Total (%)
	6.6–7.5 (%)	7.6–8.5 (%)	8.6–9.5 (%)	9.6–10.5 (%)	10.6–11.5 (%)		11.6–12.5 (%)	12.6–13.5 (%)	13.6–14.5 (%)	
<i>Boys</i>										
No PC use	18	33	19	14	31	23	25	17	14	19
Study use only	0	3	4	18	0	5	0	6	5	4
Play use only	70	52	31	32	41	45	25	23	21	23
Study and play use	12	12	46	36	28	27	50	54	60	54
<i>Girls</i>										
No PC use	35	51	15	38	24	32	15	9	17	14
Study use only	0	0	9	13	11	7	4	7	21	11
Play use only	59	30	30	23	24	33	23	22	13	19
Study and play use	6	19	46	26	41	28	58	62	49	56

Time spent by MALES with...



Time spent by FEMALES with...

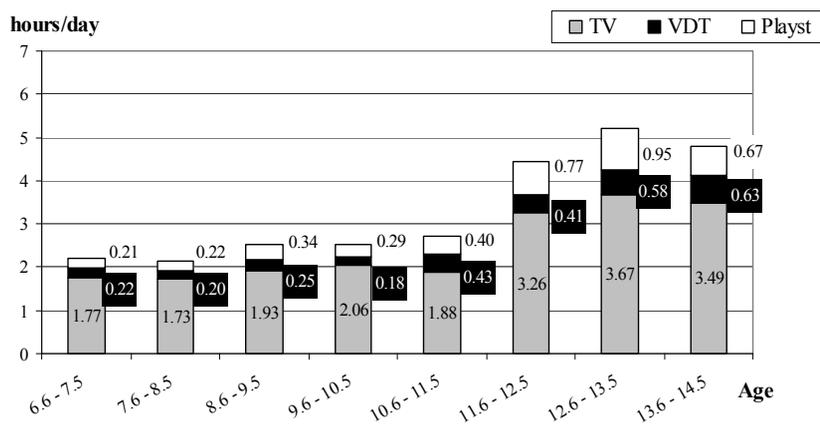


Figure 1. Hours per day spent at home in front of a television (TV), video display unit (VDT) or playstation unit (Playst) (data refer to the last school year).

averaged only 0.25–0.89 hours/day for the boys and 0.18–0.63 hours/day for the girls. It is important to recognize that our data probably tended to underestimate the real values, especially for the youngest children, as they still did not have an accurate awareness of time and they tended to underestimate it.

The presence of pain in at least one body segment was also confirmed after playstation use (22% of the girls versus 31% of the boys in elementary school and 30% of the girls versus 21% of the boys in middle school).

From the detailed analysis of the percentage of PC use by the children (table 1), we observed that computer games clearly prevail. The exclusive use of the computer for game playing showed high values, different according to gender and age, the boys' percentages being higher, especially in elementary school and particularly in the first two age classes, and also tended to decrease in middle school. On the contrary, the exclusive use for studying had low values, mainly for the boys, and reached a considerable value only for girls in the last age group in middle school. Summing the percentages of the children that utilized the PC for

game playing, we obtained striking values, higher for the boys than for the girls, particularly in elementary school (72% versus 61% in elementary school and 77% versus 75% in middle school).

The questionnaire results on sports habits confirmed the high incidence of sedentary activities in that 54% of the boys and 47% of the girls declared they never practiced any structured sport before elementary school. Then most of the students tended to practice at least one structured sport (courses on fixed days and hours, with a trainer) or a leisure-time physical activity (sport practiced without a trainer), although, on the whole, we found that 2.4% of the children in elementary school and 14% of those in middle school did not practice any sport, either structured or unstructured. We can therefore conclude that a considerable number of children, from elementary to middle school, stop most motor activity.

Table 2 shows the percentages of children that currently practiced a structured sport with a trainer. The percentages of children that did not practice a structured sport for both genders was not too high in elementary school (12% of boys and 14% of girls), but reached

Table 2. Percentage of children who practice structured sports (with a trainer) (data refer to the last school year).

Practice of structured sport	Elementary school (%)			Middle school			
	Age groups (years)		Total (%)	Age groups (years)			Total (%)
	7.6–8.5 (%)	10.6–11.5 (%)		11.6–12.5 (%)	12.6–13.5 (%)	13.6–14.5 (%)	
<i>Boys</i>							
No practice	16	8	12	22	21	30	24
One structured sport	53	56	55	66	58	52	59
More than one structured sport	31	36	34	12	21	18	17
Practice more than twice a week	5	24	15	32	36	40	36
<i>Girls</i>							
No practice	17	11	14	26	25	31	27
One structured sport	70	66	68	48	47	60	52
More than one structured sport	13	23	18	26	28	8	21
Practice more than twice a week	12	9	11	32	30	35	32

Table 3. Percentage of children who practice leisure-time sports (without a trainer) (data refer to the last school year).

Practice of leisure-time sport	Elementary school (%)			Middle school			
	Age groups (years)		Total (%)	Age groups (years)			Total (%)
	7.6–8.5 (%)	10.6–11.5 (%)		11.6–12.5 (%)	12.6–13.5 (%)	13.6–14.5 (%)	
<i>Boys</i>							
No practice	32	8	20	29	31	25	28
At least one leisure-time sport	68	92	80	70	70	74	71
Everyday practice	11	28	20	18	21	18	19
<i>Girls</i>							
No practice	73	25	49	43	32	55	43
At least one leisure-time sport	27	75	51	57	68	45	57
Everyday practice	3	8	6	4	15	2	7

30–31% in the last year of middle school, confirming the tendency (more evident for the girls) for the practice of any sport to decrease with age.

Most of the students practiced at least one structured sport (generally 1–2 times a week with a trainer). The percentages of children practicing more than one structured sport were significant, but tended to decrease in the last grade of middle school, especially among the girls. We found an increase in the number of children that practiced a structured sport more than twice a week in that the students who continued to participate in one sport, did it more frequently.

In elementary school, the boys mainly practiced basketball (28%), soccer (24%), or swimming (15%). In middle school, a high percentage continued to play soccer (24%), but they showed a general tendency to reduce sports practice, with an evident decrease in the percentages of children playing basketball (12%) and swimming (8%). A high percentage of girls practiced dance in elementary school (33%), followed by swimming (19%), volleyball (12%), and basketball (10%). In middle school, they tended to be more sedentary, but a higher percentage played volleyball (21%), while there

was a significant decrease in dancing (19%), swimming (9%), and basketball (7%).

Dissimilar, particularly for gender, are the results for leisure-time sports practice (without a trainer) shown in table 3. High percentages of the children practiced at least one leisure-time sport, and quite a few of them practiced daily; the boys in particular tended to practice more leisure-time sports than the girls (80% in elementary school, 71% in middle school versus 51–57% of the girls) and on a daily basis (20% in elementary school, 19% in middle school versus 6–7% of the girls). Passing from elementary to middle school, we found a trend towards less-structured sports, while unstructured sports showed a minor decrease for the boys and a small increase for the girls, whose percentages were nevertheless very low in comparison with those of the boys.

The leisure-time sports practiced were substantially similar to the structured ones, but they were practiced by different percentages of children. In elementary school, the boys practiced soccer (37%), basketball (14%), cycling (13%), and skiing (7%), whereas, in middle school, there was an increase in the percentage of children playing soccer (46%) and a decrease in all other sports.

The percentages of leisure-time sports practiced by the girls were all very low, both in elementary school and in middle school.

Discussion

Our results merely represent a first step in understanding the effects of the widespread use of technological devices on youngsters' health. More research is needed before an analysis can be made of age-related postural differences and their relationship with children's height (8) and their long-term effects can be evaluated.

At an early age, children are merely interested in the entertainment applications of new technology, and only in a second phase do they discover its potential use in other fields, such as study, communication, information, and so on (9, 10). Very young children are mainly attracted by the mix of lights, colors, and movements that motivate them to learn very quickly while playing different electronic games. While they have a passive role watching TV, with video games and a PC, they start to interact actively with technology, essentially for fun. With age, they make use of an increasing number of technological devices, they diversify their applications, and they spend more and more time on these devices on a daily basis.

The possession of technological tools is not negative in itself, but the very long time spent in front of different monitors (playstation, VDT, and TV) is alarming. Practically, once children are back from school, most of their free time, except homework time, is spent in front of a screen. It is evident that the dynamic lifestyle of the past—walking to school, playing outdoor games and being engaged in after-school energetic activities—has switched to a sedentary one, in which the use of technological equipment (that requires sitting or laying postures) largely prevails over physical or social activities, limiting direct interactions with other people and with the exterior physical world. This diffusion of sedentary habits has harmful physical and psychological consequences. An example is the expansion of obesity in almost all developed countries, not only in the adult population, but even among children. In our region in the last 30 years, we have observed a large increase in overweight children (5), the highest incidence of obesity is found mainly for boys until 10 years of age, with percentages in the 27–29% range, that then progressively decrease to 17–22%. Girls show lower percentages, merely 10–18%, as probably they are more influenced by environmental and cultural influences that emphasize the importance of controlling their physical aspects.

The National Diet and Nutrition Survey in the United Kingdom (11), on a sample of over 1700 young people

aged 4 to 18 years, found that 40% to 69% of children over the age of 6 years spend less than the recommended minimum of 1 hour per day doing moderately intensive physical activity. We cannot compare our results with the aforementioned research, as we do not have data about the intensity of the sports practiced by our sample. Nevertheless, tables 2 and 3 show that exercise is no longer a usual part of children's days. They spend a very large part of their time watching television, activity that requires as little energy expenditure as sleeping, while children should practice vigorous physical activities on a regular basis, several times a week.

The relationship between technology and youth in the growing-up process should be improved in terms of postural and behavioral habits (education on correct postures and on the proper use of technological devices) and in terms of hours of use.

It is important to safeguard youngsters' physical and psychological health, avoiding the spread of evermore sedentary lifestyles that, above all, lead to obesity. Youngsters should be stimulated to reject isolation in a world mediated by monitors and encouraged to prefer physical activities and sports in open spaces with friends of their same age group, in order to experience real life rather than simulated activities.

Among its recommendations, an interesting report of the Department of Health and Human Services, the Center for Disease Control and Prevention, and the Department of Education in the United States (12) includes the promotion of physical activity, a decrease in obesity, and a suggestion to introduce changes in the infrastructure of communities to encourage physical and recreational activities.

Simulated worlds shaped by video games, computers, and the Internet are shifting children's experiences from the real to the virtual (13); it is frightening that, for a significant number of children, information and communication technology is nearly becoming a way of life, a new context in which youth is being lived and that often confuses simulated and real-life scenarios (14).

Among the practical implications that may appear from this study, one of the most important is the necessity to pay more attention to the quality of children's leisure-time activities. If they tend to dedicate too much time to the use of new technologies, it is necessary to stimulate them to use their spare time in games and sports, preferably outdoors, in order to develop their basic motor abilities, health, and well-being. In order to limit the risk of children being damaged by a sedentary lifestyle and bad postural habits becoming engrained, we activated special educational projects involving not only the students, but also their parents, teachers, and educators.

We are cooperating with the Scuola Universitaria Interfacoltà in Scienze Motorie (Motor Sciences

Interfaculty University School) that, through a study completed in 1999–2000 and 2002–2003 in elementary schools of a town called Asti (lower Piedmont), pointed out a strong decrease, in the short 3-year period, in the ability of space-time organization of activities among children 9 years (28%) and 10 years (29%) of age. In addition, data regarding equilibrium showed a significant decrease of 11% (15). Other studies (16) have demonstrated the alarming fact that children's manual and motor abilities are gradually decreasing. New generations can be specialized in specific sports activities, but are no longer skilled in basic motor activities such as walking uphill, climbing, and crossing a stream without slipping. The increased tendency to be immersed in a virtual world has resulted in children's greater inability to manage in the natural environment, demonstrated by their inability to walk on irregular terrains, uphill, or downhill and the inability to use simple rope equipment.

For the aforementioned reasons, the group proposed and developed an experimental learning model for elementary and middle schools that includes more time devoted to physical activities, in addition to traditional educational programs. This new formative sports project offers families the opportunity for their children to attend physical education 10 hours per week [4 hours of general physical activity to develop motor abilities adequate for the age classes through individual disciplines (swimming, athletics, specific physical preparation, etc) and team disciplines (basketball, traditional sports, etc) and 6 hours to choose among rugby, volleyball, ice skating, and artistic gymnastics]. In addition, children will participate in student championships, matches, and cultural and sports events. During the summer, children will be invited to learn survival activities in a camp organized by Federazione Italiana Survival Sportivo e Sperimentale (FISSS), where they will be trained and monitored in some basic motor abilities. Sports education will involve not only the students, but also their parents and teachers through meetings, congresses and training sessions. We participate in the program with ergonomic courses about the correct use of new technologies, through the following main steps: (i) teaching children to limit the time spent in the use of electronic devices, stimulating their self-control for better time management, and explaining proper postural behavior to them, to avoid the risks associated with static activity and being sedentary; and (ii) informing parents and educators about what equipment and furniture are compatible with the ergonomic requirements of children, possibly adjustable, to take into account their anthropometric and physiological needs, which show considerable variations and rapid changes during the growing stage.

Our courses are coherent with the educational program "Ergonomics at School" supported by ISPELS (Istituto Superiore per la Prevenzione e la Sicurezza

del Lavoro—Superior Institute of Work Prevention and Safety) (www.ispesl.it/formaz/opuscoli/ergonomiaScuola.htm) to prevent children's illnesses, particular attention is being paid to musculoskeletal pathologies. We make use of simple pedagogical tools that seem successful in acting on children's creativity and motivation in order to sensitize them to their current experiences and to help them be able to recognize the main problems related to poor ergonomic conditions.

In the future, we intend to develop our research towards the ergonomic analysis of mobile games, which are increasingly spreading among young people, through the use of different technological tools, on one hand, mobile phones and small portable consoles with integrated displays and, on the other, the most recent video games that permit active interaction with the console.

The diffusion of mobile phones among very young children is shocking, and children often use these tools for video-game playing, concentrating their visual attention on a very small zone, with possible serious consequences to their developing visual system. In addition, the use of small portable consoles with integrated displays is rapidly expanding among children, who can easily use them during free time, out of parents' control. Their displays are larger in comparison with mobile phone displays, but the games designed for them can require a lot of visual concentration.

Vice versa, it is possible that children's musculoskeletal systems could benefit from the use of the new videogame generation instead of traditional ones. The most recent wireless controllers (Wii Remote) are based on accelerometers and gyroscopes that allow users to control the game using physical gestures, as well as traditional button presses, creating a more-natural user interface, where the player has to move as in the simulated sports. For example, in tennis, the player has to grab the controller like a racket and swing, in baseball he or she has to grip the controller like a bat. There is also a fitness option that runs through a daily series of virtual exercises to be physically active.

Our aim will be to verify whether the use of such devices, which permit dynamic interaction, may have a less dangerous effect on children, as they do not force children to maintain static postures in front of a screen, employing only oculomotor and finger muscles. We intend also to evaluate whether children tend to use them alone or whether they involve their friends or their whole family and whether the excessive use of the Wii can cause physical damage. We will also verify other safety aspects, as it is possible that uncontrolled dynamic movements in a confined environment, such as a standard room full of furniture and objects, could cause injuries. Even this new kind of entertainment, which may or may not become popular among children, still involves the following two crucial problems—particularly when

children do not play with friends or family members: the lack of interaction with real people and the pervasive technological mediation that transfers thoughts, images, and experiences in a virtual world, far from every form of the natural environment, populated by human beings, "impaled upon a ray of sun", as our Nobel prize poet Salvatore Quasimodo stated (17).

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