

ORIGINAL PAPER

Desirable and undesirable lifestyle changes in Polish children resulting from the COVID-19 pandemic

Michalina Rucińska¹, Natalia Rutkowska¹, Magdalena Skowronek¹, Paweł Matusik², Agnieszka Zachurzok³

¹Department of Paediatrics and Paediatric Endocrinology, School of Medicine in Katowice, Medical University of Silesia, Katowice, Poland

²Department of Paediatrics, Paediatric Obesity, and Metabolic Bone Diseases, Chair of Paediatrics and Paediatric Endocrinology, School of Medicine in Katowice, Medical University of Silesia, Katowice, Poland

³Department of Paediatrics, School of Medicine in Zabrze, Medical University of Silesia, Katowice, Poland

ABSTRACT

Introduction: This study hypothesized that the lockdown due to the COVID-19 pandemic implemented in Poland on 11 March 2020 negatively influenced the lifestyle, dietary and sleeping habits, and physical activity of Polish children. The study aimed to assess the change of children's lifestyle habits, and screen and sleep time due to measures taken during this lockdown.

Material and methods: The study was cross-sectional and involved 486 parents of children aged 3–18 years, who completed the questionnaire containing 37 questions related to sociodemographic factors, nutrition, physical activity, and screen and sleep time regarding the child before and during lockdown.

Results: During the lockdown, the number of meals consumed daily increased significantly in children between 7 and 11 years old (0.19 ± 0.68 , $p < 0.001$) and 12 and 18 years old (0.24 ± 0.81 , $p = 0.005$), whereas it decreased in the youngest group (3–6 years old) (-0.11 ± 0.66 , $p < 0.001$). The declared consumption of fast food decreased in all groups ($p < 0.001$), whereas the number of responders who prepared meals at home increased significantly (95.9% vs. 98.4%, $p = 0.02$). The time of physical activity decreased significantly during the lockdown in the groups of older children ($p < 0.001$), especially in children who live in blocks of flats. In the youngest group of children, the declared time of physical activity did not change significantly. In all groups of children, the screen time increased significantly during the pandemic. The amount of sleep also increased in all age groups but its quality worsened.

Conclusions: It can be concluded that the lockdown due to the COVID-19 pandemic generated mainly undesirable lifestyle changes (decreased physical activity, increased screen time); however, desirable effects (increase in meals eaten at home and amount of sleep) were also observed.

KEY WORDS:

children, lifestyle, COVID-19 pandemic.

INTRODUCTION

The SARS-CoV-2 was first identified in December 2019 in Wuhan, China and then rapidly spread worldwide. In Poland the first case was announced on 4 March 2020. A week later, on 11 March, the World Health Organization

declared a pandemic. On the same day the Polish Government implemented lockdown measures, resulting in closing schools, kindergartens, shopping centres, offices, and leisure activity places, even those located outdoors. During these first months of lockdown the most severe restrictions were implemented. It was due to the lack

ADDRESS FOR CORRESPONDENCE:

Prof. Agnieszka Zachurzok, Department of Paediatrics, School of Medicine in Zabrze, Medical University of Silesia, Katowice, Poland, e-mail: agnieszkazachurzok@poczta.onet.pl

of knowledge about SARS-CoV-2 biology – contagiousness, survival outside the host, etc. – as well as lack of health care system preparation for the massive number of infected patients in emergency conditions. The life of most children changed dramatically from day to day. Such strict measures can have an impact on dietary habits, physical activity, and the amount of sleep and screen time among children and adults [1–4]. It was found that children might be more affected by the long-term consequences of the lockdown than adults [5]. Every day activities related to outside physical activity were dramatically reduced in favour of sedentary time, mainly spent in front of a computer [6, 7]. Already before the pandemic only 22.8% of adolescent boys and 7.5% of adolescent girls in Poland achieved the recommended amount of physical activity [8]. It was shown that during the pandemic only 3.6% of Canadian children and 2.6% of Canadian adolescents met the guidelines of 60 minutes daily physical activity [9]. Also among Polish children a similar trend could be observed: the number of days with 60 minutes of physical activity dropped from 3.89 before COVID-19 to 3.30 [7]. Children's school and social life were moved from “real life” to “virtual life”. Their screen time was significantly increased [10, 11], and it was observed that children watched more movies, especially during weekends [7]. Moreover, the amount of children who watched more than 6 hours daily was nearly 5 times higher [7]. The stress related to the pandemic and the dramatic changes in everyday life due to lockdown could lead to serious health consequences including obesity and its comorbidities due to unhealthy eating habits and physical activity restriction, psychological consequences related to social isolation, and computer overuse and addiction [12, 13]. Moreover, in children a lack of appropriate physical activity could lead to disturbed physical development and postural defects.

This study hypothesized that the lockdown during the COVID-19 pandemic negatively influenced the lifestyle, dietary and sleeping habits, and physical activity in the population of Polish children. Thus, the study aimed to assess the effect of the measures taken during the first month of the COVID-19 pandemic on children's behaviours.

MATERIAL AND METHODS

The study was cross-sectional and involved 486 parents of children aged 3–18 years (mean age 7.9 ± 3.9 years, 242 female/244 male), who filled out the study questionnaire. It was conducted in April 2020 during the most restricted national quarantine introduced by the Polish government due to the SARS-CoV-2 epidemic. The survey was closed when the restrictions were relaxed and after sufficient data was obtained. Assuming that the population of children in Poland is about 6,000,000, for a 5% error threshold and a test power of 0.95 the appropriate sample size would be 384 participants.

The study used a self-prepared questionnaire containing 37 questions, 11 related to sociodemographic factors and 26 to nutrition, physical activity, screen time, and sleep regarding the child before the pandemic and during lockdown (Supplement 1). It was created on Google Forms® and propagated by social media platforms such as Facebook®, WhatsApp®, and Instagram®. Because it was an online survey, the non-probability sampling method was used. The questionnaire was placed on parents/mothers groups pages in social media, and the users were asked to propagate the questionnaire among their acquaintances (convenience sampling and snowball sampling). The questionnaire was pre-tested in a group of 40 parents to verify if the questions were easily understandable. The final version of the questionnaire was prepared according to pretested respondents' suggestions. Responses regarding children under the age of 3 years were not considered.

Participation was fully voluntary and anonymous, and respondents gave their informed consent to participate in the study by signing at the beginning a statement attached to the study. Due to the age of children, the study group was divided into 3 age categories: preschool children in the age of 3–6 years ($n = 229$), younger school children in the age of 7–11 years ($n = 166$), and older school children in the age of 12–18 years ($n = 91$).

The study was conducted according to the Helsinki declaration and approved by the Local Ethics Committee (PCN/0022/KB1/89/20).

The statistical analysis was performed using Statistica 13.3 PL. The quantitative variables were described with a mean (standard deviation), and qualitative variables were defined by frequency (%). Normal distribution of data was checked with the Kolmogorov-Smirnov test. We used the χ^2 test for qualitative data comparison of groups, and dependent sample t-Student test for quantitative data comparison of groups, as appropriate. $P < 0.05$ was considered statistically significant.

RESULTS

Descriptive data regarding children and their housing characteristics are presented in Table 1.

EATING HABITS

Both before and during lockdown, most meals were prepared at home. However, during the lockdown, respondents were even more likely to prepare their meals on their own. Almost all parents (95.9%) declared that most of their meals were prepared at home before the pandemic, and during the lockdown, this proportion increased to 98.4% ($p = 0.02$). Moreover, during the pandemic, a significant decrease in fast-food consumption was observed in all 3 age subgroups (Table 2). Two-thirds of parents (61.6%) declared not consuming fast food before the pandemic, and during the lockdown this proportion increased sig-

TABLE 1. Children's ages and residence characteristics

	Children (<i>n</i> = 486)		Female (<i>n</i> = 242)		Male (<i>n</i> = 244)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Age group						
3–6 years	229	47.1	117	24.1	112	23.1
7–11 years	166	34.2	75	15.4	91	18.7
12–18 years	91	18.7	50	10.3	41	8.4
Type of residence						
Village	117	24.1	70	14.4	47	9.7
City < 100,000 inhabitants	133	27.4	67	13.8	66	13.6
City > 100,000 inhabitants	236	48.5	106	21.8	130	26.7
House	247	50.8	137	28.2	110	22.6
Block of flats	237	49.2	105	21.6	134	27.6

TABLE 2. Children's eating habits before and during the lockdown

	Before the pandemic	During the pandemic	Δ	<i>p</i>
Sweets consumption (rated 1–5)	2.81 ± 0.97	3.05 ± 1.07	0.23 ± 0.95	< 0.001
3–6 years	2.74 ± 0.95	2.96 ± 1.06	0.22 ± 0.90	< 0.001
7–11 years	2.86 ± 0.1.00	3.15 ± 1.06	0.29 ± 0.97	< 0.001
12–18 years	2.89 ± 0.98	3.08 ± 1.13	0.19 ± 1.06	0.097
Fast-food consumption (rated 1–5)	1.51 ± 0.76	1.25 ± 0.58	–0.25 ± 0.75	< 0.001
3–6 years	1.41 ± 0.65	1.21 ± 0.53	–0.21 ± 0.69	< 0.001
7–11 years	1.52 ± 0.73	1.27 ± 0.53	–0.35 ± 0.75	< 0.001
12–18 years	1.73 ± 0.98	1.34 ± 0.73	–0.39 ± 0.85	< 0.001
The number of meals (per day)	4.25 ± 0.76	4.30 ± 0.74	0.06 ± 0.71	0.086
3–6 years	4.50 ± 0.63	4.39 ± 0.70	–0.11 ± 0.66	< 0.001
7–11 years	4.14 ± 0.74	4.33 ± 0.72	0.19 ± 0.68	< 0.001
12–18 years	3.80 ± 0.82	4.04 ± 0.83	0.24 ± 0.81	0.005

1: never, 2: 1–2 times a week, 3: 3–4 times a week, 4: 1 time a per day, 5: more than one time a day

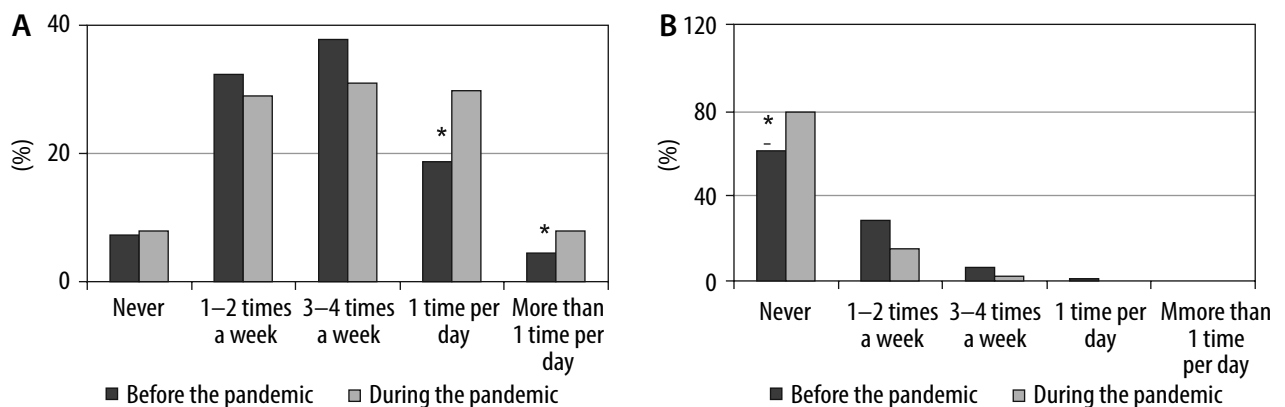


FIGURE 1. Frequency of consumption of sweets (A) and fast-food (B) before and during the lockdown

**p* < 0.05

nificantly to 79.8% (*p* < 0.001) (Figure 1). During the lockdown, the number of meals consumed daily increased significantly in children between 7 and 11 years (*p* < 0.001) and in teenagers (*p* = 0.005), whereas it decreased in the youngest group (*p* < 0.001).

The proportion of children who ate sweets several times a day almost doubled: from 4.5% before the pandemic to 7.6% during the lockdown (*p* = 0.04) (Figure 1). Overall, 23.1% (112) of respondents reported that, prior to quarantine, sweets were consumed at least once a day.

TABLE 3. Children's physical activity and screen time before and during the lockdown, as declared by their parents

	Before the pandemic	During the pandemic	Δ	<i>p</i>
Time of physical activity per day (rated 1–5)	2.84 ± 1.20	2.34 ± 1.26	–0.50 ± 1.42	< 0.001
3–6 years	2.72 ± 1.11	2.67 ± 1.29	–0.04 ± 1.35	0.589
7–11 years	2.94 ± 1.20	2.05 ± 1.13	–0.89 ± 1.29	< 0.001
12–18 years	2.94 ± 1.39	2.03 ± 1.19	–0.91 ± 1.49	< 0.001
The amount of sleep per day (rated 1–6)	4.96 ± 0.88	5.24 ± 0.74	0.28 ± 0.89	< 0.001
3–6 years	5.28 ± 0.97	5.33 ± 0.77	0.06 ± 0.90	0.34
7–11 years	4.88 ± 0.60	5.24 ± 0.66	0.36 ± 0.80	< 0.001
12–18 years	4.33 ± 0.68	5.03 ± 0.72	0.70 ± 0.85	< 0.001
Screen time with school duties per day (rated 1–6)	2.26 ± 1.23	3.79 ± 1.69	1.53 ± 1.98	< 0.001
3–6 years	2.12 ± 1.09	2.91 ± 1.40	0.79 ± 1.72	< 0.001
7–11 years	2.36 ± 1.32	4.16 ± 1.52	1.79 ± 2.01	< 0.001
12–18 years	2.44 ± 1.34	5.32 ± 1.28	2.88 ± 1.74	< 0.001
Screen time without school duties per day (rated 1–6)	2.10 ± 1.09	3.06 ± 1.48	0.96 ± 1.17	< 0.001
3–6 years	1.83 ± 0.96	2.72 ± 1.31	0.89 ± 0.95	< 0.001
7–11 years	2.05 ± 0.91	3.14 ± 1.48	1.09 ± 1.28	< 0.001
12–18 years	2.88 ± 1.29	3.78 ± 1.71	0.90 ± 1.42	< 0.001

Physical activity: 1: 15–30 minutes per day, 2: 30–60 minutes per day, 3: 1–2 hours per day, 4: 2–3 hours per day, 5: more than 3 hours per day

Sleep: 1: less than 2 hours, 2: 2–3 hours, 3: 4–5 hours, 4: 6–7 hours, 5: 8–10 hours, 6: more than 10 hours per day

Screen time: 1: less than 1 hour, 2: 1–2 hours, 3: 3–4 hours, 4: 4–5 hours, 5: 6–7 hour, 6: more than 10 hours per day

During the quarantine, this number increased by 15% (73) and amounted to 37% (180) ($p < 0.001$).

PHYSICAL ACTIVITY

The declared time of physical activity decreased significantly during the lockdown in the groups of older children ($p < 0.001$ in children 7–11 years old, $p < 0.001$ in children 12–18 years old). In the youngest group of children the declared time of physical activity did not change significantly ($p = 0.6$) (Table 3). During the pandemic, the number of children who declared physical activity for more than one hour per day decreased 55.8–37.8% ($p < 0.001$), and the number of children who practiced sport for less than 30 minutes per day increased 13.1% to 31.7% ($p < 0.001$) (Figure 2). The decreased in the amount of physical activity was higher among children living in a block of flats, so without garden space rather than in a house (-0.78 ± 1.39 vs. -0.22 ± 1.39 , $p < 0.001$). During the pandemic, the number of children living in a block of flats who declared undertaking physical activity for more than one hour per day decreased 59–30% ($p < 0.001$), whereas among children living in a house it decreased 53–45% ($p < 0.001$).

SLEEP

The amount of sleep increased significantly during the lockdown in the whole group of children ($p < 0.001$); the highest increase was observed in the teenager groups (Table 3). In the youngest group of children, the amount of sleep during the lockdown did not change. During

the lockdown, significantly more children slept for more than 12 hours (10.7% of respondents before the pandemic vs. 31.1% of respondents during the lockdown, $p < 0.001$) (Figure 2). Moreover, more children reported sleep problems during the pandemic (23.3% of children) than before (18.1% of children, $p = 0.048$). Respondents declared more problems especially with falling asleep (15.6% of children during lockdown vs. 10.7% of children before the pandemic, $p = 0.02$) (Figure 3).

SCREEN TIME

In all the groups of children, their screen time increased significantly during the pandemic ($p < 0.001$). This increase was greatest in children aged 12–18 years ($p < 0.001$). Before the pandemic, in 77.2% of children the screen time was less than 2 hours per day, whereas during lockdown only 28.2% of children spent less than 2 hours per day looking at a screen ($p < 0.001$) (Figure 2). When the screen time related to school duties was excluded, a significant increase of screen time during free time was present in all age groups ($p < 0.001$).

DISCUSSION

This study assesses the effect of lockdown due to the COVID-19 pandemic on children's dietary habits, physical activity, and amount of sleep and screen time, on the basis of a self-prepared questionnaire completed by the parents of 486 children. We observed that during the lockdown, the number of meals consumed daily increased significantly in children above the age of 7 years and decreased in younger

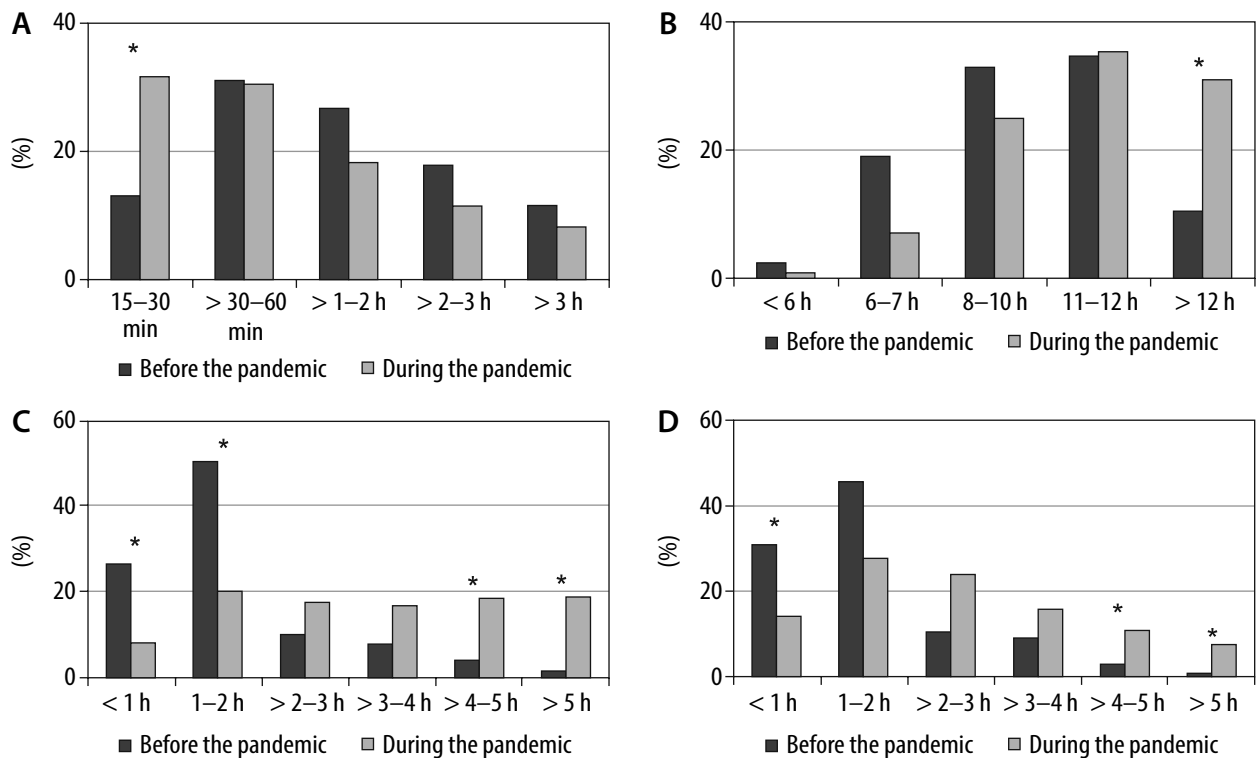


FIGURE 2. Physical activity (A), sleep (B) and screen time with (C) and without (D) school duties per day

* $p < 0.05$

children. Moreover, the declared consumption of sweets increased significantly, and the increase was the highest in children 7–11 years old. During the lockdown a significant decrease of declared time of physical activity and an increase in the amount of sleep among children above the age of 7 years was also seen. However, more children reported sleep problems during the pandemic. The screen time increased during the pandemic in all groups of children.

EATING HABITS

In most other studies that analysed the eating habits before and during quarantine a change in eating behaviours was observed [6, 14–16]. Frequently an increased number of meals eaten per day was reported [1]. It was observed that during the lockdown the number of meals consumed daily was significantly increased in children older than 7 years, but it decreased in younger children. Possible explanations for the increased number of meals in older children could be more frequent snacking [1], stress eating [2, 3], lack of parental supervision when children stayed home while parents were working, and the excessive amount of food at home due to “panic shopping” at the beginning of the pandemic. It is worth mentioning that restrictive shop opening hours resulted in choosing more highly processed, calorie-dense products and less fruit and vegetables [3, 15, 16]. More detailed data about changes of eating habits of Polish children during the pandemic were shown by Łuszczki *et al.* [13]. They reported that during lockdown the frequency of consumption of most products decreased, but

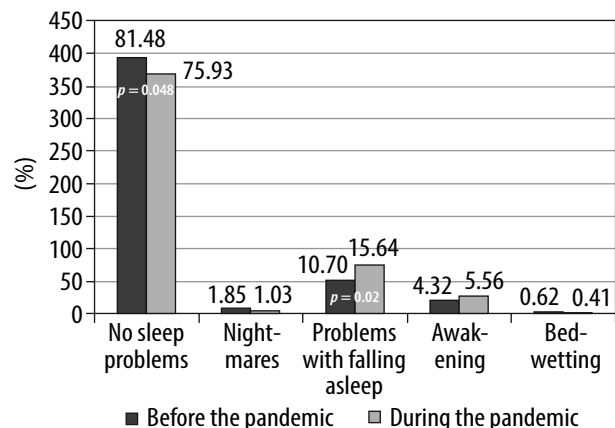


FIGURE 3. The prevalence of sleep problems before and during the lockdown among Polish children aged 3–18 years ($n = 486$)

milk, fish, poultry, and meat product consumption increased [13]. Moreover, as in other reports, we observed that more meals were prepared at home, and that fast food consumption was significantly lower ($p < 0.001$) [1]. During the lockdown not only did Polish children stay at home but also a lot of parents worked from home. It has been observed that almost 70% of Polish women were offered home office in this time [10]. Meanwhile, restaurants and bars were closed, which could be the reason why more meals were prepared at home, and less fast food was consumed. However, in some households, because of the higher number of meals prepared by parents working from home, the lockdown could lead to more regular meal consumption and a beneficial increase in the number of meals eaten by older children.

A trend of higher consumption of sweets was observed ($p < 0.001$), especially among children 7–11 years old ($p < 0.001$). Most studies confirm that finding [4, 13, 14]. Some studies suggest that this could be a consequence of the stressful situation, frustration, as well as lack of personal contact with friends and teachers [17, 18]. It was also found that boredom increases the intake of unhealthy foods and results in greater calorie intake. Another reason could be that parents provided children with sweets to entertain them while working from home [18]. During confinement, parents reported fewer rules and limits and gave children more autonomy in food choices [18]. In this study, it was found that during the quarantine the number of children who consumed sweets at least once a day increased significantly. Increased consumption of sweets has many negative effects, such as a higher risk of obesity, cardiovascular disease, type 2 diabetes mellitus, metabolic syndrome, and nonalcoholic fatty liver disease [19, 20]. Moreover, consumption of sweets is often associated with consumption of high-fat foods, such as potato chips, French fries, etc., which is another risk factor for the mentioned diseases [21].

LIFESTYLE

In terms of physical activity, the most dramatic changes were observed in the age groups above 7 years old ($p < 0.001$). This was repeatedly found in other studies [1, 2, 4, 15]. Lockdown measures, such as restrictions to leaving one's house, resulted in very limited opportunities to participate in outdoor or indoor activities. Online learning reduced the daily activities associated with transportation from/to school or around the school (stairs etc). In 2016 around 50% of Polish children aged 11–17 years walked to school or back from school, which contributed to meeting the weekly physical activity recommendations [22]. We found that during the pandemic, the number of children who declared physical activity for more than one hour per day decreased significantly 55.8–37.8% of participants ($p < 0.001$). The decrease in the amount of physical activity was higher among children living in a block of flats, and hence without garden space, rather than in a house. Most children (70%) living in blocks of flats devoted less than 60 minutes a day to physical activity during the lockdown. However, among children living in houses, this number was also high (55%), despite access to gardens. Children younger than 7 years old did not change their physical activity habits; it is supposed that their activities were not dependent on schools or sports clubs (which were closed during the lockdown in Poland) but on their parents' or guardians' arrangements. The pandemic had a positive influence on the amount of sleep, especially among teenagers. The study showed that during the lockdown, significantly more children slept for more than 12 hours. The main causes of inadequate sleep among adolescents are early school times, excessive homework, evening screen time, caffeine intake, and extracurricular

activities [23]. During the lockdown teenagers stopped participating in after-school activities, and therefore had the chance to study earlier during the day and could go to bed earlier. Also, the commute time was excluded, and so despite the same school start time children could sleep longer. Moreover, some studies observed lower caffeine intake during the lockdown [24]. However, during the lockdown more parents reported sleeping disturbances in their children, especially problems with falling and staying asleep and somnolence during the day. Some studies confirm our finding [25, 26]. Dondi *et al.* [25] showed that children had 69.3% greater difficulty in falling asleep, 30.2% in staying asleep, and an 18.7% increase in nightmares and/or sleep terrors during lockdown. However, Liu *et al.* [27] contradict this finding, reporting fewer sleeping problems in a group of preschool children. Some children were also found to develop sleep-waking and sleep breathing disorders during the night [26]. This could be a result of increased screen time, alternations in daily routine, lower activity during the day, and higher stress levels [17, 25, 28]. Some studies found that a job loss in a family was correlated with children's difficulties staying asleep during the night [25].

Certainly, one negative effect of the pandemic was increased screen time. In our cohort of children their screen time increased significantly during the pandemic ($p < 0.001$), and this increase was greatest in teenagers. During the pandemic the number of children using electronic devices for less than 2 hours per day was almost 3 times lower than before the pandemic. Half of the children who used screen-based media for less than 2 hours per day before the lockdown increased their screen time to more than 2 hours per day during the lockdown. It can be supposed that children at home were using more screen-based media in their free time because there were no outdoor activities allowed. Additionally, a factor that contributed highly to this change was the introduction of online learning. However, even when school duties were excluded, the screen time remained higher than before the lockdown. The lack of extracurricular activities, sports training, and limited social interactions resulted in higher usage of cell phones and computers during their free time. It is worth emphasizing that excessive screen time was repeatedly found to be a risk factor for mental health issues among children and adults, and it can disrupt children's psychological development [29–31].

STRENGTHS AND LIMITATIONS

The limitations of our study are the self-prepared questionnaire without broader validation and the small amount of socioeconomic data due to the length of the questionnaire. Moreover, the method of survey propagation (non-probability sampling) does not give certainty that our sample is representative of the Polish population. However, looking at the structure of the Polish population about 60% of citizens live in urban areas; in our cohort we

had only a slight overrepresentation of children living in small and big cities compared to children living in rural areas (24.1%) (Table 1). Additionally, eating habits were assessed with questions about sweets and fast-food consumption, and about the number of meals eaten in a day. Other eating habits were not assessed (Table 2).

The strength of our study is the time at which the survey was performed. It was the second month of the most restricted lockdown, which was implemented in Poland at the same beginning of the COVID-19 pandemic. During this time the lives of Polish children and their parents changed most dramatically. Another advantage of our paper is the analysis of eating habits, physical activity, and screen time in respect to the age subgroup, which gives an indication of which children would need the most attention and in which area during such a situation.

CONCLUSIONS

It can be concluded that the lockdown due to the COVID-19 pandemic significantly changed the lifestyle of children of every age. Most changes were undesirable (decreased physical activity, increased screen time). However, a desirable increase in meals eaten at home and the amount of sleep were also observed. Moreover, an increase in the number of meals consumed at home was also observed, which could be considered as a positive change, assuming that the nutrient quality was adequate. Those changes were partially related to the age group. Also, an increase in sweet consumption in younger children and a decrease of physical activity in school children and adolescents were observed. The negative effects of these changes could be weight gain and an increased obesity rate, bad posture, chronic sleep problems, etc. [11, 31, 32]. Therefore, it is important to emphasize the significance of healthy lifestyle promotion during the lockdown. Unfortunately, sleeping disturbances were more common during the lockdown and were probably related to stress [25]. Our study showed the need of working up strategies such as promoting adequate physical activity, eating a healthy diet, and responsible use of screen-based media, in respect to the children's age, to preserve their health during lockdowns related to the still present COVID-19 and any future pandemic.

DISCLOSURE

The authors declare no conflict of interest.

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