

The long-term impact of the COVID-19 pandemic on children with ADHD in terms of participation, support, and barriers at home



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ABSTRACT

Purpose: The purpose of this study was to compare the long-term impact of the COVID-19 pandemic on participation, support, and barriers at home in children with attention deficit hyperactivity disorder (ADHD) and without ADHD.

Design and methods: This study included a total of 227 participants with a mean age of 11.93 ± 2.96 years, comprising 116 children and adolescents with ADHD and 111 without ADHD. The parents or primary caregivers of all the children completed the Participation and Environment Measure for Children and Youth (PEM-CY), which was used to assess participation and environmental factors in the home. The Student's *t*-test was used to compare numeric data and Chi-square test to categorical data between children and adolescents with ADHD and those without ADHD in all three settings.

Results: The children with ADHD were determined to play computer and video games significantly more than children without ADHD ($p < 0.001$). The mean frequency of participation in arts, crafts, music, hobbies ($p < 0.001$), school preparation (< 0.0001), and homework (< 0.003) was significantly higher in children without ADHD. A moderate effect size ($\phi = 0.42$) was determined in respect of cognitive demands making it more difficult for children with ADHD to participate in home activities than children without ADHD.

Conclusions: Children with ADHD were negatively affected in terms of participating in home activities than their typically developing peers. In addition, cognitive demands prevented their participation and involvement in the home environment while cognitive demands were a support for non-ADHD children.

Practical implications: A highlight of this research was the comprehensive investigation of the long-term effect of the COVID-19 pandemic on participation in all activities at home, in addition to the support and barriers in the home environment for children with ADHD compared to typically developing peers.

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Introduction

The COVID-19 pandemic caused various challenges for children and adolescents around the world due to the confinement and restrictions on their daily routines, less motivation, remote education difficulties, boredom, and social isolation (Melegari et al., 2021; Sibley et al., 2021). These difficulties resulted in behavioral issues such as anxiety, impatience, sadness, boredom, and inattention for children and adolescents worldwide (Lee, 2020; Panda et al., 2021; Wang et al., 2020). With prolongation of the COVID-19 pandemic, children with attention deficit

hyperactivity disorder (ADHD) may be especially sensitive to these challenges due to their basic symptoms of hyperactivity, inattention and impulsivity (Cortese et al., 2020; Melegari et al., 2021).

Many studies have examined the immediate impact of the COVID-19 pandemic on children and adolescents with ADHD, and have shown conflicting results. Some recent studies have reported that greater exposure to stress during the COVID-19 pandemic exacerbated ADHD symptoms and family conflicts in teenagers with ADHD (Cortese et al., 2020; Lee, 2020; Wang et al., 2020). Furthermore, sleep issues, problematic media use, and lack of exercise were observed in children and adolescents with ADHD (Becker, 2020; Cortese et al., 2020; Thoma et al., 2020). However, in some other studies, periods of lockdown have been shown to have improved anxiety and stress by reducing school

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activities and excluding social challenges such as peer persecution and rejection, as well as the fear of failure (Melegari et al., 2021). The primary immediate benefits of lockdown included more time with family, more time for academic work, and a reduction in anxiety (Sibley et al., 2021). These findings support our previous findings that children with ADHD participated in more activities at home during COVID-19 than before, and that cognitive and social demands did not constitute barriers at home (Kaya Kara et al., 2021). Consequently, children and adolescents with ADHD may benefit from a supportive and adaptable environment (Kaya Kara et al., 2021; Melegari et al., 2021).

Participation has become particularly crucial in neurobehavioral disorders during childhood (Engel-Yeger & Ziv-On, 2011; Law, 2002). Based on the International Classification of Functioning, Disability and Health (ICF) model, participation is defined as involvement in life situations and it has been highlighted that the role of participation as well as the role of context depends on personal characteristics and living environments (World Health Organization, 2001). To the best of our knowledge, only one previous study has examined children with ADHD in respect of participation in all settings, including home, school, and community (Shabat et al., 2021). It has been reported that children with ADHD are less involved in activities at home, school, and in community settings than children without ADHD, with a lower frequency of participation at home (Shabat et al., 2021). However, there is still a substantial gap in knowledge regarding the long-term effects of the COVID-19 pandemic on home participation in children and adolescents with ADHD.

Therefore, the purpose of this study was to evaluate the longstanding impact of the COVID-19 pandemic on participation, support, and barriers in the home environment of children and adolescents with ADHD compared to non-ADHD peers. The hypothesis of the study was that children with ADHD would have a lower frequency of participation and involvement, and more barriers in the home environment than their healthy peers.

Methods

Participants

The study included a total of 227 participants with a mean age of 11.93 ± 2.96 years, comprising 116 children and adolescents with ADHD and their primary caregivers who were referred to the Child and Adolescent Psychiatry Department between March and September 2022, and 111 children and adolescents without ADHD and their parents who agreed to participate. The inclusion criteria were defined as children and adolescents in the age range of 6–17 years, diagnosed with ADHD by a child and adolescent psychiatrist using the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders. The exclusion criteria were defined as the diagnosis of another psychiatric disorder, such as autism spectrum disorder, anorexia nervosa, or psychotic symptoms, or unwillingness to participate in the study. The inclusion criteria for children and adolescents without ADHD were defined as children and adolescents in the age range of 6–17 years, not diagnosed any psychiatric and neurologic diseases. They were the typically developing peers of children and adolescents with ADHD.

Measures

Sociodemographic questionnaire

The parents or primary caregivers completed this questionnaire to provide information about the family cultural status, such as family income, maternal education level, demographic data of age, sex, and body mass index (BMI), and medical history.

Participation and environment measure for children and youth

The Participation and Environment Measure for Children and Youth (PEM-CY) is a parent-reported questionnaire used to assess participation and environmental factors in the home, school, and community

(Coster et al., 2011). The participation category contains ten items related to the home, five items related to school, and ten items to the community. Parents are asked to determine the participation frequency (how frequently the child is involved with eight options ranging from daily to never), participation involvement (how involved the child is while participating in the activity with a 5-point scale ranging from very involved to minimally involved), and preferred change for each activity (do the parents want to see a change in the participation of the child in this type of activity: yes or no). Following completion of the participation section, environmental features are examined to identify supports and barriers (do environmental features help or constrain the child's participation in activities at home/school/community setting). The home setting contains 12 items, the school setting contains 17 items, and the community setting contains 16 items. The PEM-CY has been shown to be reliable and valid for the assessment of children (Kaya Kara, Turker, Kara, & Yardimci-Lokmanoglu, 2020). According to a psychometric analysis study of 178 children without disability and 210 children with a disability, the PEM-CY had moderate to very strong internal consistency and test-retest reliability, (Cronbach's alpha = 0.67–0.93; Intraclass correlation coefficients (ICCs) = 0.67–0.80) (Kaya Kara, Turker, Kara, & Yardimci-Lokmanoglu, 2020).

Procedure

Approval for this study was granted by the University Local Ethics Committee. The parents or legal guardians of all the study participants provided written consent in accordance with the principles stated in the Helsinki Declaration. Parents/primary caregivers who agreed to take part in the study completed the socio-demographic form and PEM-CY. PEM-CY was performed on both parents of the children with and without ADHD by a paediatric physiotherapist with three years of experience in the child and adolescent psychiatry department. The children and adolescents with ADHD included in the study were those who had been routinely referred to the child and adolescent psychiatry department. The children and adolescents without ADHD comprised the children of neighbours, relatives, and family friends of the researchers. The first case of COVID-19 in our country was reported on 11 March 2020. The first lockdown in Turkey began on April 4, 2020, and gradual normalization began on June 1, 2021. The government removed all restrictions since 1 July 2021 in Turkey and the "new-normal process" began. Face-to-face education was resumed in all schools by September 6, 2021. The requirement to wear a face mask in public, with the exception of hospitals, was repealed on May 29, 2022. Therefore, the study participants were evaluated between March 2022 and September 2022 to determine the long-term consequences of COVID-19.

Statistical analysis

Data obtained in the study were analyzed statistically using the Statistical Package for the Social Sciences (SPSS) version 23 for Macintosh software (IBM SPSS Statistics; IBM Corporation, Armonk, NY, USA). Conformity of the data to normal distribution was assessed using the Shapiro-Wilk test, histograms, and Q-Q-plot, and the data were normally distributed. The sample size was calculated using GPower V.3.1.9 software (University of Kiel, Kiel, Germany) with partial eta squared ($d = 0.40$), which was reported for the home involvement (Shabat et al., 2021). A sample size of 32 participants was required for each group at least to achieve 80% power to detect a difference with 95% confidence using F tests. The Student's *t*-test was used to compare participation frequency and involvement differences between children and adolescents with ADHD and those without ADHD in all three settings. The Chi-square test was used to compare the proportions of never participating, desire for change, environmental support, and barriers between the groups in all three settings. Bonferroni corrections were applied to divide the number of comparative tests performed for each set of analyses by the significance level of 0.05. Cramer's V and *r*

coefficient was used to report effect size and was classified as small (0.10–0.29), moderate (0.30–0.49), or large (0.50–1.00). A value of $p < 0.05$ value was considered statistically significant.

Results

The sociodemographic characteristics of all the study participants are shown in Table 1. The mean age of children with and without ADHD was 11.7 and 12.04 years old, respectively, and nearly 75% of the children were male. Almost half of the children with ADHD used medication to manage their symptoms. There were no statistically significant differences in mean age, BMI, sex, school type, or maternal education level between children with and without ADHD. More children without ADHD (44.1%) had more than two siblings than children with ADHD. The parents of children with ADHD were more likely to be divorced (18.1%), and they lived in urban areas (87.1%) with a lower-than-average family income (53.4%) than the parents of children without ADHD.

Participation

The mean frequency and percentages of never participating in activities at home of children with and without ADHD are shown in Table 2. Children with ADHD were found to participate in computer and video games at home significantly more than children without ADHD ($p < 0.0001$, $r = 0.29$) (Supplementary File 1). The mean frequency of participation in arts, crafts, music, hobbies, school preparation, and homework was significantly higher in children without ADHD, with small to moderate effect sizes ($p < 0.005$, $r = 0.19$ – 0.47). In children with ADHD, the percentage of home activities in which they never participated was higher, including socializing via technology ($p < 0.0001$,

$\phi = 0.25$), household chores ($p < 0.001$, $\phi = 0.21$), and school preparation ($p < 0.004$, $\phi = 0.18$).

Children with ADHD played computer and video games at a significantly higher rate than children without ADHD (Table 3). Children without ADHD were determined to have a higher level of involvement in socializing using technology and face-to-face with a small effect size (Supplementary File 1). There were also significant differences in the level of involvement in school preparation and homework, with effect sizes ranging from moderate to large ($p < 0.005$, $r = 0.39$ – 0.56). The mothers of children with ADHD reported at a higher level the wish to change their child's participation in computer and video games ($p < 0.0001$, $\phi = 0.29$), indoor play and games ($p < 0.002$, $\phi = 0.207$), socializing with others ($p < 0.0001$, $\phi = 0.32$), household chores ($p < 0.004$, $\phi = 0.19$), school preparation ($p < 0.0001$, $\phi = 0.41$) and homework ($p < 0.0001$, $\phi = 0.29$) (Supplementary File 1).

Environment

The home environment barriers and supports for children with and without ADHD are shown in Tables 4 and 5 (Supplementary File 2). With a moderate effect size, cognitive demands made it more difficult for children with ADHD to participate in home activities than children without ADHD ($p < 0.0001$, $\phi = 0.42$). It was determined that with a moderate effect size, cognitive demands of children without ADHD did not affect or usually assisted them participate in home activities. The majority of mothers of children with ADHD reported that the services ($p < 0.0001$, $\phi = 0.23$) and supplies ($p < 0.004$, $\phi = 0.19$) in their home environment were adequate to support their children's participation in home activities, compared to the mothers of children without ADHD. The mothers of children without ADHD reported that supplies in the home environment sometimes helped but sometimes did not

Table 1
Socio-demographic characteristics of participants ($n_{\text{with ADHD}} = 116$, $n_{\text{without ADHD}} = 111$).

	With ADHD		Without ADHD		p ^{a,b}
	Mean (SD)		Mean (SD)		
Child age (y)	11.7 (3.09)		12.04 (2.95)		0.103 ^a
Age at diagnosis (y)	8.01 (1.43)		–		–
BMI (kg/m ²)	19.22 (3.13)		18.96 (3.6)		0.56
Mothers' age (y)	38.51 (6.27)		40.09 (5.14)		0.04 ^{a, *}
Child gender	n	%	n	%	0.52 ^b
Male	93	80.2	85	76.6	
Female	23	19.8	26	23.4	
Drug use for ADHD					
Yes	61	52.6	–		
No	55	47.4	–		
Number of siblings					0.048 ^{b, **}
0	19	16.4	14	12.6	
1	64	55.2	48	43.2	
>2	33	28.4	49	44.1	
Type of school					0.24 ^b
Elementary	47	40.5	47	42.3	
Secondary	45	38.8	50	45	
High School	24	20.7	14	12.6	
Marital status, mother					<0.001 ^{b, **}
Married	95	81.9	110	99.1	
Divorced /Widowed	21	18.1	1	0.9	
Level of education, mother					0.48 ^b
Elementary school	32	27.6	35	31.5	
Secondary school	21	18.1	13	11.7	
High School	41	35.3	37	33.3	
University/ Graduate degree	22	19	26	23.4	
Type of community					0.002 ^{b, *}
Urban	101	87.1	78	70.3	
Rural	15	12.9	33	29.7	
Family Income (monthly)					0.006 ^b
Below average	62	53.4	36	32.4	
Average	48	41.4	67	60.4	
Above average	6	5.2	8	7.2	

p^a Student's t-test, p^b Chi square test, *p < 0.05 ** p < 0.001, BMI: Body Mass Index.

Table 2
Frequencies of home participation and never participation of children with ADHD and without ADHD.

Home participation items	Participates				Never participates				Cramer's V (ϕ)	
	With ADHD Mean (SD)	Without ADHD Mean (SD)	p^a	Effect Size (r)	With ADHD		Without ADHD			p^b
					n	%	n	%		
1. Computer and video game	5.6 (2.3)	4.3(2.7)	<0.0001	0.29	14	12.1	27	24.3	0.016	0.159
2. Indoor play and games	3.8 (2.9)	4.1(2.5)	0.619	0.032	38	32.8	22	19.8	0.027	0.147
3. Arts, crafts, music and hobbies	5.4 (2.2)	6.4 (1.2)	0.001	0.23	12	10.3	3	2.7	0.021	0.154
4. Watching TV, videos and DVDs	6.1(1.7)	6.2 (1.4)	0.686	0.026	7	6	4	3.6	0.394	0.057
5. Getting together with other people	6.7 (0.8)	6.6 (1.1)	0.863	0.011	1	0.9	2	1.8	0.535	0.041
6. Socializing using technology	3.8 (3.1)	5.3 (2.3)	0.007	0.177	43	37.1	16	14.4	<0.0001	0.258
7. Household chores	5.4 (2.2)	5.7 (1.2)	0.155	0.094	13	11.2	1	0.9	<0.001	0.214
8. Personal care management	6.6 (1.3)	6.9 (0.2)	0.284	0.071	4	3.4	0	0	0.048	0.131
9. School preparation (not homework)	3.6 (2.6)	6.2 (1.1)	<0.0001	0.47	13	11.2	2	1.8	0.004	0.189
10. Homework	5.6 (2)	6.3 (1.1)	0.003	0.19	10	8.6	1	0.9	0.007	0.180

p^a , Mann–Whitney *U* test; Comparison using Mann–Whitney *U* test (Bonferroni adjustment of the significance level was set at $p^a < 0.005$ for home) p^b , χ^2 -test test, Comparison using χ^2 -test (Bonferroni adjustment of the significance level was set at $p^b < 0.005$ for home). Significant *p* values are shown in bold. Effect sizes (ϕ , *r*) are rounded to two decimal points and interpreted as small (0.10–0.29), moderate (0.30–0.49) or large (0.50–1.00).

improve their children's participation in home activities ($p < 0.001$, $\phi = 0.22$).

Discussion

The aim of the current study was to examine the long-term impact of the COVID-19 pandemic in children with ADHD in respect of participation in home activities, and the barriers and support in comparison to non-ADHD peers. In terms of the hypothesis to determine group differences, it was determined that children with ADHD differed from their peers in terms of participation frequency, involvement and mothers' request for change in home activities, as well as support and barriers at home.

Many studies investigated the impact of lockdown in the early months of the COVID-19 pandemic on the mental health, behavioral and emotional changes of children with ADHD, and caregiver quality of life, and family burden (Iovino et al., 2021; Melegari et al., 2021; Pecor et al., 2021; Sibley et al., 2021; Zhang et al., 2020). Periods of lockdown during the COVID-19 pandemic caused many major difficulties for children and adolescents all over the world (Melegari et al., 2021). Given the restrictions, numerous new adaptations and adaptive changes were required. According to recent research, long-term boredom causes increased anxiety, unstable emotional mood, and behavioral problems in the general population (Cao et al., 2020; Wang et al., 2020). The European ADHD group reported that children with ADHD are more sensitive to stress as a result of lockdown and have greater intolerance of unknown situations than their peers (Cortese et al., 2020; Melegari et al., 2021). Cortese et al. (Cortese et al., 2020) found that changes in

daily routines, as well as difficulties at home and in the social environment, resulted in a more severe increase in hyperactivity and impulsivity behaviors. The COVID-19 pandemic is ongoing and people must adapt to a new normal process, which may have long-term consequences for children with ADHD and their parents (Borel et al., 2022).

One of the most serious issues for children with ADHD and their parents was the increase in screen time during the COVID-19 pandemic (Sciberras et al., 2022; Thoma et al., 2020). In contrast, Rosenthal et al. (Rosenthal et al., 2022) discovered no differences in media use between ADHD and control groups when assessed in March 2021. According to the findings of this study, children with ADHD participated in computer and video games at a rate 23.2% more than children without ADHD. In addition, there was a 20.5% increase in the involvement in computer and video games in children with ADHD than their peers. In a previous study, Kara et al. demonstrated that children with ADHD spent more time at home with playing computer and video games at the beginning of the COVID-19 pandemic than pre-COVID-19 (Kaya Kara et al., 2021). Similarly, Sciberras et al. (Sciberras et al., 2022) found that playing computer games increased during the pandemic in children with ADHD, and that this was related to increased stress. These findings indicate that during the COVID-19 pandemic, children with ADHD may have developed a habit of playing computer and video games more than their peers.

Investigation of the participation and involvement in daily activities of children with ADHD in the home environment is a forgotten topic in the literature (Kaya Kara et al., 2021). The majority of studies have examined the academic performance of children with ADHD (Engel-Yeger & Ziv-On, 2011). A few studies have reported that children with

Table 3
Involvement of home participation and change desired of children with ADHD and without ADHD.

Home participation items	Involvement				Mothers' Desires Change				Cramer's V (ϕ)	
	With ADHD Mean (SD)	Without ADHD Mean (SD)	p^a	Effect Size (r)	With ADHD		Without ADHD			p^b
					n	%	n	%		
1. Computer and video game	4.03 (1.7)	3.2 (2.05)	0.001	0.210	74	63.8	38	34.2	<0.0001	0.296
2. Indoor play and games	2.8 (2.2)	3.7 (1.9)	0.004	0.189	51	44	27	24.3	0.002	0.207
3. Arts, crafts, music and hobbies	3.9 (1.6)	4.5 (1)	0.009	0.172	55	47.4	38	34.2	0.044	0.134
4. Watching TV, videos and DVDs	4.1 (1.4)	4.2 (1.2)	0.885	0.0009	55	47.4	53	47.7	0.96	0.003
5. Getting together with other people	4.2 (1.2)	4.7 (0.8)	0.002	0.210	41	35.3	9	8.1	<0.0001	0.329
6. Socializing using technology	2.7 (2.2)	3.8 (1.7)	0.001	0.220	38	32.8	42	37.8	0.423	0.053
7. Household chores	3.2 (1.8)	3.5 (1.2)	0.597	0.035	54	46.6	73	65.8	0.004	0.193
8. Personal care management	4.1 (1.4)	4.7 (0.5)	0.002	0.203	27	23.3	15	13.5	0.058	0.126
9. School preparation (not homework)	2.3 (1.7)	4.4 (1.1)	<0.0001	0.566	67	57.8	19	17.1	<0.0001	0.419
10. Homework	2.8 (1.7)	4.1 (1.1)	<.0001	0.392	76	65.5	40	36	<0.0001	0.295

p^a , Mann–Whitney *U* test; Comparison using Mann–Whitney *U* test (Bonferroni adjustment of the significance level was set at $p^a < 0.005$ for home).

p^b , χ^2 -test test, Comparison using χ^2 -test (Bonferroni adjustment of the significance level was set at $p^b < 0.005$ for home).

Significant *p* values are shown in bold. Effect sizes (ϕ , *r*) are rounded to two decimal points and interpreted as small (0.10–0.29), moderate (0.30–0.49) or large (0.50–1.00).

Table 4
Perceived supportiveness of the home environment in children with ADHD and without ADHD.

Home environment	Usually makes harder				Sometimes helps/Sometimes makes harder				Usually helps/not an issue									
	With ADHD		Without ADHD		p ^b	Cramer's V (φ)	With ADHD		Without ADHD		p ^b	Cramer's V (φ)						
	n	%	n	%			n	%	n	%								
1. Physical layout	6	5.2	5	4.5	0.815	0.016	8	6.9	19	17.1	0.017	0.158	102	87.9	89	80.2	0.110	0.106
2. Sensory qualities	7	6	6	5.4	0.838	0.014	18	15.5	15	13.5	0.669	0.028	91	78.4	92	82.9	0.398	0.056
3. Physical demands	8	6.9	3	2.7	0.141	0.098	14	12.1	16	14.4	0.602	0.035	94	81	94	84.7	0.466	0.048
4. Cognitive demands	46	39.7	5	4.5	<0.0001	0.421	27	23.3	25	22.5	0.893	0.009	43	37.1	83	74.8	<0.0001	0.379
5. Social demands	6	5.2	2	1.8	0.169	0.091	26	22.4	16	14.4	0.121	0.103	84	72.4	95	85.6	0.015	0.161
6. Relationship with family members	9	7.8	5	4.5	0.308	0.068	31	26.7	18	16.2	0.054	0.128	76	65.5	90	81.1	0.008	0.176
7. Attitudes	30	25.9	3	2.7	<0.0001	0.328	31	26.7	5	4.5	<0.0001	0.304	57	49.1	105	94.6	<0.0001	0.503

p^b, χ^2 -test test, Comparison using χ^2 -test (Bonferroni adjustment of the significance level was set at $p^b < 0.007$ for home). Significant p values are shown in bold. Effect sizes (ϕ , r) are rounded to two decimal points and interpreted as small (0.10–0.29), moderate (0.30–0.49) or large (0.50–1.00).

ADHD are less involved in social and ability-based activities than their typically developing peers (Engel-Yeger & Ziv-On, 2011; Mimouni-Bloch et al., 2018; Shimoni et al., 2010). The findings of this current study demonstrated that children with ADHD participated in arts, crafts, music, and hobbies 18.5% less than their peers, but the mean frequency of participation in arts, crafts, music, and hobbies of children with ADHD were similar to the findings of Kara et al. (Kaya Kara et al., 2021), who identified a significant increase in the involvement rate of these activities at the beginning of the COVID-19 pandemic compared to pre-COVID-19. This present study findings also showed that a higher percentage of children with ADHD reported never participating in socializing using technology, or in household chores than children without ADHD. However, the current study results indicated that children with ADHD participated and were as equally involved in household chores as their peers. Kara et al. (Kaya Kara et al., 2021) demonstrated that the mean participation frequency of household chores was similar to the current study findings and was significantly higher in children with ADHD at the beginning of the pandemic than pre COVID-19. It appears that the COVID-19 pandemic encouraged many children with ADHD to help their families with household tasks. Household chores are essential for developing responsibility in the home and transferring these skills to adulthood (Dunn, Coster, Orsmond, & Cohn, 2009). When children assist family members with daily housework, they can improve their communication and social skills, abilities, self-reliance, and self-determination (Dunn, Coster, Cohn, & Orsmond, 2009; Dunn, Coster, Orsmond, & Cohn, 2009).

The current study findings showed a 40.7% decrease in socializing using technology in children with ADHD than their non-ADHD peers. Kara et al. (Kaya Kara et al., 2021) indicated that 60% of children with ADHD reported never participating in socializing using technology at the beginning of the COVID-19 pandemic. The findings of the current study showed that the percentage of children with ADHD who never used technology for socializing was reduced over the long-term of the COVID-19 pandemic, but there was still a significant difference when

compared to their peers. These findings might be caused by the social challenges of children with ADHD such as poor social skills, inappropriate behaviors, and social isolation (Lasmono et al., 2021; Lee et al., 2021; Morris et al., 2021; Zendarski et al., 2021). Furthermore, children with ADHD are known to have more difficulties socializing with their peers, receive more negative feedback from their teachers, and are exposed to social isolation as a result of ADHD symptoms (Demaray et al., 2009; Morris et al., 2021). When the involvement rate of socializing with other people and personal care management was compared in the Kara et al. study (Kaya Kara et al., 2021), the results of the current study were similar to those reported at the beginning of the COVID-19 pandemic. However, the current study findings showed an 11.9% decrease in the involvement rate of socializing with other people and a 14.6% decrease in personal care management in children with ADHD compared to their non-ADHD peers. In line with these findings, children with ADHD require more support than their peers to improve their relationships with other people at home, and they are more involved in self-care activities.

Unlike the current study findings, which revealed numerous differences in home activities between children with and without ADHD, Rosenthal et al. (Rosenthal et al., 2022), found no significant differences in daily activities between children with and without ADHD during the COVID-19 pandemic. This could be because the current study examined home activities more thoroughly than Rosenthal et al. (Rosenthal et al., 2022). This highlights the significance of using ICF-based and self-reported questionnaires to determine differences in daily activity participation between ADHD children and their peers who had face-to-face contact with the researcher (Imms et al., 2016).

Based on the current study findings, the mean participation frequencies of 72.2% in school preparation including preparing backpack, clothes, etc. and 12.4% in homework, were lower than for their healthy peers. When the results were compared with the findings of Kara et al. (Kaya Kara et al., 2021), there was a 29.4% decrease in the mean frequency of participation in school preparation during the long-term

Table 5
The resources of the home environment in children with ADHD and without ADHD.

Home environment	Usually no				Sometimes yes/Sometimes no				Usually yes									
	With ADHD		Without ADHD		p ^b	Cramer's V (φ)	With ADHD		Without ADHD		p ^b	Cramer's V (φ)						
	n	%	n	%			n	%	n	%								
1. Services	0	-	0	-	-	-	7	6	9	8.1	0.542	0.04	96	82.8	69	62.2	<0.0001	0.231
2. Supplies	5	4.3	3	2.7	0.511	0.044	11	9.5	30	27	0.001	0.228	100	86.2	78	70.3	0.004	0.194
3. Information	4	3.4	6	5.4	0.473	0.048	14	12.1	24	21.6	0.054	0.128	98	84.5	81	73	0.034	0.141
4. Time	8	6.9	3	2.7	0.141	0.098	30	25.9	27	24.3	0.789	0.018	78	67.2	81	73	0.346	0.063
5. Money	8	6.9	2	1.8	0.062	0.124	32	27.6	29	26.1	0.804	0.016	76	65.5	80	72.1	0.287	0.071

p^b, χ^2 -test test, Comparison using χ^2 -test (Bonferroni adjustment of the significance level was set at $p^b < 0.01$ for home). Significant p values are shown in bold. Effect sizes (ϕ) are rounded to two decimal points and interpreted as small (0.10–0.29), moderate (0.30–0.49) or large (0.50–1.00).

COVID-19 pandemic. The current study findings revealed an 91.3% decrease in involvement in school preparation, and a 46.4% decrease in homework with high to moderate effect sizes in children with ADHD compared to their peers. This could be a sign of the negative impact of being out of school for a prolonged period of time. These results supported previous findings that children with ADHD were less involved in school preparation activities than their peers during the COVID-19 pandemic, and that school activities were more difficult for children with ADHD than their non-ADHD peers (Nguyen et al., 2019; Rosenthal et al., 2022). Difficulties in accessing online education or hybrid schooling during the pandemic process could have aggravated educational difficulties experienced by children with ADHD (Rosenthal et al., 2022). According to recent studies, remote learning presents more difficulties for children with ADHD than for their peers (Becker et al., 2020; Breaux et al., 2022; Rosenthal et al., 2022; Tessarollo et al., 2022). Returning to school after prolonged COVID-19 restrictions may have increased problems for children with ADHD. Thus, the participation of children with ADHD in school activities should have been expanded over the course of the COVID-19 pandemic.

In line with these findings, the mothers of children with ADHD wanted to reduce their children's exposure to computer and video games, and to increase participation in indoor play and games, socializing with other people, school preparation and homework more than mothers of children without ADHD. Interestingly, the mothers of children with ADHD also wanted to increase their child's involvement in household chores despite the fact that there were no differences in household chore involvement rates between the children with and without ADHD. This could be because the parents of children with ADHD criticized their children more than the parents of children without ADHD (Engel-Yeger & Ziv-On, 2011). According to Sibley et al. (Sibley et al., 2021), the most common COVID-19 pandemic problems for parents of children with ADHD were motivation, social isolation, and access to online education. Related to these challenges during the COVID-19 pandemic, the burden of parents of children with ADHD gradually increased (Iovino et al., 2021), which could then have an effect on the children.

ADHD is characterized by attention deficit, hyperactivity, and impulsivity, resulting in functional disability in social environments (Barkley et al., 2006). This neurobehavioral disorder has a negative impact on cognitive demands such as learning ability, social interactions, self-esteem, and emotions (Wang et al., 2017). The current study findings revealed that cognitive demands are the most significant barrier to participation in home activities in children with ADHD. Cognitive demands include concentration, attention, problem-solving, and impulsivity (Coster et al., 2012). The parents of children with ADHD reported that cognitive demands make it challenging for the children to participate and become involved in activities at home, whereas the parents of children without ADHD stated that cognitive demands greatly helped their children's participation in home activities. During the COVID-19 pandemic, Kara et al. (Kaya Kara et al., 2021) found that a two-month lockdown at the beginning of the pandemic improved participation frequency and involvement in home-related activities, and reduced barriers such as cognitive and social demands at home (Kaya Kara et al., 2021). This positive effect could be related to ADHD children spending more time with their family members (Kaya Kara et al., 2021). Previous findings supported that symptoms in children with ADHD can improve with environmental support and feedback (Kaya Kara et al., 2021). During the COVID-19 pandemic, Sibley et al. (Sibley et al., 2021) identified major issues and benefits for children with ADHD and their parents. Spending more time with family and reduced anxiety were among the top benefits of the COVID-19 pandemic, according to parents and children with ADHD (Sibley et al., 2021). Consequently, limiting school activities and socialization at the beginning of the COVID-19 pandemic could reduce anxiety and stress in children with ADHD (Melegari et al., 2021). The lockdown may have been a protective measure against common social stressors for children with ADHD, as this could result in

less peer victimization, time constraints at school, and exclusion from their peers (Melegari et al., 2021). However, extending the pandemic restrictions and reintroducing socialization after a long period of time may have had a negative impact on children with ADHD (Cao et al., 2020; Wang et al., 2020). Nevertheless, the social exclusion of children with ADHD can have an impact on participation in community activities (Murray-Close et al., 2010). Further research is needed to examine the impact of participation in community activities on children with and without ADHD. Furthermore, there is an urgent need to investigate the participation patterns of children with ADHD and their relationship with ADHD symptoms.

Based on the findings of the current study, the resources of the home environment including services and supplies had a greater impact on supporting the participation of children with ADHD. However, the parents of children without ADHD reported that supplies in the home environment such as sports equipment, handcraft materials, books, and technological devices were not always adequate to support their child's participation. These findings demonstrated that the parents of children without ADHD have higher expectations of their children (Arakelyan et al., 2019, 2020). Children without ADHD participate in more arts, crafts, music, and hobbies at home than children with ADHD, so they require more equipment and materials.

Limitations and strengths

The large sample size and comparison of findings with a control group were the study's main strengths. Another strength of our study is the use of a valid and reliable measurement tool, as well as statistical analysis. PEM-CY is one of the most useful tools to evaluate participation patterns as well as environmental features according to the ICF framework. The possible limitation of the present study is cross-sectional design. However, we believe that it is crucial to show the differences of home participation patterns in children with ADHD and their typically developing peers after two years of COVID-19 and to discuss the acute effect of lockdown together with current research. Another limitation of this study is the familiarity of the participants in the control group. To avoid bias, the PEM-CY was performed on the parents by an independent assessor who is a three-year experienced paediatric physiotherapist. In addition, another limitation could be that the PEM-CY is a parent-report questionnaire, determining the involvement rate of children may be difficult.

Implications to practice

Children with ADHD were negatively affected in terms of participating in home activities than their typically developing peers based on the long-term effect of COVID-19. Children with ADHD participate frequently and were more involved in computer and video games than their typically developing peers. Cognitive demands prevented their participation and involvement in the home environment while cognitive demands were a support for non-ADHD children.

Conclusion

A highlight of this research was the comprehensive investigation of the long-term effect of the COVID-19 pandemic on participation in all activities at home, and the support and barriers in the home environment of children with ADHD compared to typically developing peers. In conclusion, these findings showed that children with ADHD were negatively affected in terms of participating in home activities than their typically developing peers. In addition, cognitive demands prevented their participation and involvement in the home environment while cognitive demands were a support for non-ADHD children. Also, children with ADHD played more video games and were less involved in preparing school and homework activities than their health

peers. Future research should investigate how cognitive demands affect participation in school and community-based activities.

CRedit authorship contribution statement

Ozgun Kaya Kara: Writing – original draft, Conceptualization, Methodology. **Sebahat Yaprak Cetin:** Visualization, Investigation, Data curation, Software. **Duygu Turker:** Visualization, Investigation. **Seval Kutluturk Yikilmaz:** Investigation. **Seval Tamer:** Data curation, Software. **Koray Kara:** Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pedn.2023.03.009>.

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