



Impact of play restriction during the COVID-19 pandemic on mental well-being in children with a chronic condition

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Abstract

This study is to investigate the effects of social restrictions, induced by the COVID-19 pandemic, on play behavior, and the associations with mental well-being in children with a chronic physical condition. Additionally, we explored potential moderating effects of environmental factors. Data from the PROactive cohort study including children with a chronic physical condition was used. Play behavior was measured with a self-developed questionnaire distributed during the pandemic with questions concerning behavior before and during the pandemic (with whom they most often played, where, and how many days/week (face-to-face and online)). Mental well-being, including life satisfaction, quality of life, and internalizing symptoms were assessed during the pandemic. Analyses were performed separately for the ages 8–12 years and 13–18 years. Differences in play behavior were analyzed with McNemar's and Wilcoxon signed-rank tests. Linear regression analyses were used to analyse associations between play behavior and mental well-being. *P*-values were adjusted for false discovery rate. Interaction terms were added with several environmental factors, to explore potential moderating effects. In total, 756 participants (8–12 years: $n=261$; 13–18 years: $n=495$) were included in this study. Differences in play behavior between pre-pandemic and during the pandemic were observed. With whom they mostly played (friends/family members), compared to playing alone, was related to mental well-being in both age groups. Moreover, for children between 13 and 18 years playing outside was positively associated with life satisfaction and negatively related to internalizing symptoms. Experiencing a negative influence of the pandemic on leisure time, social support, and distress of the child are potential moderators. *Conclusions:* The COVID-19 pandemic induced changes in play behavior. During the pandemic, mainly not playing alone, but with friends or family members, and for older children playing outside, was related to better mental well-being in children with a chronic physical condition.

What is known:

• *Children with a chronic physical condition are at risk for developing social and emotional problems, that include depressive symptoms, anxiety, aggression, physical impairment and problems in academic and social functioning. These problems may be related to limitations in play activities these children are thought to experience. However, there is limited empirical data to relate limitations in play and mental well-being in these children.*

What is new:

• *The COVID-19 pandemic presented an opportunity to investigate alterations in play behavior in relation with mental well-being among children with a chronic physical condition. Based on data from the PROactive cohort, including data for children with a chronic condition, we determined the impact of the pandemic on play in these children and related it to their mental well-being. Our data emphasize the importance of play, and particular playing with others, for mental-well-being and may facilitate prevention strategies for children growing up with a chronic condition.*

Keywords Play · Pandemic · Mental well-being · Chronic illness · Pediatrics · PROactive cohort study

Abbreviations

CI Confidence interval
FDR False discovery rate

PedsQL-4.0-GCS-C PedsQL Generic Core Scale
RCADS Revised Child Anxiety and Depression Scale
SES Socio-economic state

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Introduction

In the Netherlands, nearly 1 million children and adolescents between 0 and 25 years of age, further referred to as children, suffer from a chronic condition [1]. Two-thirds of these children have a somatic disorder, such as cystic fibrosis, auto-immune disorders, or congenital heart disease. It has been found that children with a chronic physical condition have an increased risk of developing social and emotional problems, which may vary by condition [2–4]. These health issues include depressive symptoms, anxiety, aggression, physical impairment, and problems in academic and social functioning [5–7].

Play is of utmost importance for healthy social and emotional development. Play is fun and we recognize play when we see it. But play is more than fun. Play behavior enables children (and other mammals) to experiment and practice motor, cognitive, and social skills, and develop emotional resilience. Consequently, play is important for children to thrive in adulthood [8–10]. Unfortunately, children with a chronic physical condition may be limited in the extent and diversity of their play activities [11]. This can be attributed to factors such as hospitalization, side effects of the disease, and/or medication, including pain and fatigue, but also other consequences of the condition, such as social isolation and the “other-than-normal” treatment these children may encounter. Restrictions in play behavior might contribute to a higher risk for mental health issues in children with a chronic physical condition.

During the COVID-19 pandemic, various restrictive regulations were implemented. These restrictions, including the closure of schools, compelled children, and adolescents to stay inside, affecting how they spent their (free) time [12]. These restrictions affected the children’s opportunities to play [13–16] and their mental well-being [17, 18]. Research in rats has shown that social play deprivation impacts social, emotional, cognitive, and sensorimotor development [19, 20]. Therefore, it is likely that the COVID-19 restrictions may have, through play limitations, affected children’s physical and psychological health [15, 21]. Normally, exploring the effects of social play restriction in humans poses evident ethical obligations [11]. However, the COVID-19 pandemic presented an opportunity to investigate alterations in play behavior and the relation with mental well-being among children with a chronic physical condition, who seem vulnerable to developing mental health issues [22, 23]. Knowledge on the impact of restrictions in play in relation to mental well-being in children with a chronic condition is important considering that play is important for children to socially interact with their families and care givers, but also as a means to reduce the negative impact of isolation they encounter, by reducing borecom and loneliness for example [24].

In the current study, we determined (1) whether play behavior in children with a chronic condition changed during the pandemic compared to before the pandemic, (2) if (a change in) play behavior during the pandemic is related to mental well-being, and (3) whether environmental factors, such as feeling supported, moderated the relation between (a change in) play, and mental well-being.

Materials and methods

Preregistration

The current study was preregistered on the Open Science Framework before conducting the analyses (<https://osf.io/h5juw>).

Design and population

We used data from the PROactive cohort study [25] (OSF PROactive Cohort Study Scripts). The PROactive cohort operates within an academic hospital as a care-focused initiative. Pediatric specialists at PROactive choose whether to include psychosocial questionnaires in their departments, and patients and parents’ consent to their care data being used for research, allowing their inclusion in this study. Therefore, the selection of disease groups is driven by clinical care priorities rather than predefined research hypotheses. In this article, we did not further select disease groups within PROactive but included all available groups to provide a comprehensive overview. More information about the PROactive cohort can be found [25] [source: DataverseNL]. The PROactive cohort study has a continuous longitudinal design. Measurements are once a year and are ongoing. The exact timing is based on appointments within clinical care. In the PROactive cohort children with a chronic condition (cystic fibrosis, juvenile idiopathic arthritis, systemic autoimmune diseases, chronic kidney disease, primary immunodeficiency, autoinflammatory conditions, inflammatory bowel disease, congenital heart disease, and children with medically unexplained symptoms (MUS)) are included when they are between 2 and 18 years of age usually 1 year after diagnosis or first presentation at the Wilhelmina Children’s Hospital in Utrecht, the Netherlands. All participants and parents (or legal representatives) provided written informed consent. The study was classified by the institutional review board as exempt of the Medical Research Involving Human Subjects Act (16–707/C and 17–078/C) and adhered to all local laws and the declaration of Helsinki.

We primarily used data from an additional child-reported questionnaire distributed amid the COVID-19 pandemic. Only children with complete data for this questionnaire were included. In the case of multiple measurements with

completed COVID-19 questionnaires, only the first measurement was included. This approach was chosen because the constraints were most severe in the early period of the pandemic and we aimed to determine the effects of these constraints on play in relation to mental well-being. The COVID-19 questionnaire was introduced in our cohort study just over 4 months after the first registered COVID-19 infection in the Netherlands. The delay in distribution was primarily caused by (1) the initial overwhelm affecting everyone, including researchers, (2) the development of the questionnaire itself, and (3) its subsequent integration into our data collection system. In a recent publication by Hoefnagels et al. [26] that we published on COVID-19, we provide detailed information on the timing of the child-reported questionnaire distribution.

Measures

Child-reported mental well-being

Life satisfaction was assessed with the question “Looking at the past period, how do you feel about your life during the coronavirus (COVID-19) outbreak?”. This question is based on the Cantril Ladder of Life [27, 28]. Answers range from 1 (worst life I can imagine) to 10 (best life I can imagine).

Mental well-being, or quality of life, was assessed with the PedsQL Generic Core Scale (PedsQL-4.0-GCS-C) (23 items; five answer possibilities) [29]. A total score for psychosocial functioning was calculated, using the emotional, social, and school functioning scales (scale: 0–100).

Internalizing symptoms were assessed with the Revised Child Anxiety and Depression Scale (RCADS) (47 items; four answer possibilities [30, 31]. A previous study using the same cohort data showed a high correlation between the domains of “anxiety” and “depression” [26]. Therefore, we only calculated and analyzed the total score (scale: 0–141).

Play behavior

An additional questionnaire was distributed during the pandemic which addressed play behavior both before and since the outbreak of the pandemic (Supplemental Table 1), alongside life satisfaction. In this COVID-19 pandemic questionnaire, there were five complementary play-related questions that children were required to answer twice (before and since the start of the pandemic): who: with whom did/do you play the most (three categories: alone, friends, and family members); where: where did/do you play the most (two categories: indoors and outdoors); how many days/week face-to-face: how often did/do you get together with friends (not online) (interval scale (days/week); five levels [0, 0.5, 1, 3, 7]); how many days/week online: how often did/do you chat with friends (online)

(interval scale (days/week); five levels [0, 0.5, 1, 3, 7]); how: what do you mainly do/play in your free time? (14 prespecified play activities; multiple answers possible).

Moderators

Exploratively, we determined whether the relation between (a change in) play behavior and mental well-being was moderated by certain factors. Therefore, we determined how children experienced the pandemic (How do you think the coronavirus outbreak has influenced what you do in your leisure time? (nominal; negative/positive/no change)), the presence of siblings (nominal; yes/no), social support (six items; answers 0–2) (ratio scale: 0–12) (Supplemental Table 2), parental distress since the beginning of the pandemic (16 items; answers 0–4) (ratio scale: 0–64) (Supplemental Table 3), and distress of the child since the beginning of the pandemic (17 items; answers 0–4) (ratio scale: 0–68) (Supplemental Table 4).

Covariates

Sex was self-reported and age was calculated from the dates of birth and assessment. Zip code was converted to a score for socio-economic state (SES) based on publicly available data from statistics the Netherlands (CBS) from 2019 [32]. The final covariate, school closure status, was a binary variable (yes/no) based on pandemic-related school closures at the time of questionnaire completion (Rijksinstituut voor Volksgezondheid en Milieu. Webpage COVID Data on Confirmed Cases, 2021), and whether parents held essential occupations, allowing their children to attend school.

Statistical analysis

All analyses were conducted using statistical software packages in R version 4.2.2 [33]. Analyses for the first two aims were performed separately for two age categories (8–12 years; 13–18 years), due to suspected differences in play behavior and consequently effects on mental well-being [11, 34]. Multiple imputation procedures (100×) were used to handle missing data in covariates and the outcome measure “PedsQL-4.0-GCS-C” [35].

For the first aim, to investigate differences in play behavior before and during the pandemic, we performed McNemar’s tests for categorical variables and the non-parametric Wilcoxon signed-rank tests for continuous variables. The 14 play activities are presented descriptively in histograms (Fig. 1).

For the second aim, to investigate the relation between play behavior and mental well-being, we performed linear regression analyses including all covariates (sex, age, SES, and school closure status) for play behavior during the pandemic (“who,” “where,” “how many days/week

face-to-face,” and “how many days/week online”) and mental well-being during the pandemic (life satisfaction: Cantril Ladder of Life, quality of life: PedsQL-4.0-GCS-C, and internalizing symptoms: RCADS). Additionally, to investigate the relation between a change in social contact (face-to-face and online) and mental well-being, difference scores were calculated for “how many days/week face-to-face and online” and were regressed on mental well-being. The effects of categories within categorical variables were evaluated in comparison with a reference category.

Exploratively, the third aim was to investigate whether certain factors, mentioned in section “Moderators,” moderated the relation between play behavior and mental well-being, specifically life satisfaction. We repeated the analyses of the second aim for the Cantril Ladder of Life and included the independent variable and potential moderating factor individually in the model, as well as their interaction term. Moderation analyses included all covariates and were performed with the total dataset to increase power.

As a sensitivity analysis, to investigate results in children with only MUS, we repeated the analyses of the first aim and second aim with the outcome measure “life satisfaction” in this subpopulation.

P-values of the first two aims were adjusted for false discovery rate (FDR) and considered significant when < 0.05 . Moderation and sensitivity analyses were exploratory and are presented with uncorrected *p*-values.

Results

Participants

In total, 756 participants were included in the analyses (8–12: $n = 261$; mean age = 10.1 years (SD = 1.4); 13–18: $n = 495$; mean age = 15.5 years (SD = 1.6)) (Table 1). The general pediatrics patient group (children with MUS) was well represented in both age categories (8–12: 36.4%; 13–18: 58.2%).

Differences in play behavior before and during the COVID-19 pandemic

For children in the age category 8–12 years, there was a significant change during the pandemic compared to before the pandemic in with whom children played ($p_{\text{adjusted}} < 0.001$), in where they played ($p_{\text{adjusted}} = 0.002$), in how many days/week face-to-face ($p_{\text{adjusted}} < 0.001$), and in how many days/week online ($p_{\text{adjusted}} < 0.001$) (Table 2).

For children between 13 and 18 years of age, a significant change occurred during the COVID-19 pandemic compared to before the pandemic in with whom children played ($p_{\text{adjusted}} < 0.001$), in how many days/week face-to-face ($p_{\text{adjusted}} < 0.001$), and in many days/week online ($p_{\text{adjusted}} < 0.001$) (Table 2). By contrast, the difference in where they played was not significant ($p_{\text{adjusted}} = 0.112$).

Differences in types of play behavior are summarized in Fig. 1.

Relations between play behavior and mental well-being

For children aged 8–12 years, there was a positive relation between playing with friends, compared to playing alone, and better quality of life ($\beta = 14.40$ (95% CI 7.00; 21.80), $p_{\text{adjusted}} < 0.001$) and less internalizing symptoms ($\beta = -12.32$ (95% CI 19.67; -4.97), $p_{\text{adjusted}} = 0.003$) (Table 3). We found a positive relation between playing with family members, compared to playing alone, and quality of life ($\beta = 13.11$ (95% CI 5.72; 20.50), $p_{\text{adjusted}} = 0.002$) and a negative relation with internalizing symptoms ($\beta = -12.82$ (95% CI -20.20; -5.45), $p_{\text{adjusted}} = 0.002$). How many days/week the child got together with friends during the pandemic was related to better quality of life ($\beta = 1.62$ (95% CI 0.63; 2.60), $p_{\text{adjusted}} = 0.004$). Where the child played, the different scores of how many days/week face-to-face and how many days/week online (and the difference score) were not related to mental well-being ($p_{\text{adjusted}} > 0.05$).

For children aged 13–18 years, we found positive relations between playing mostly with friends, compared to playing alone, and better life satisfaction ($\beta = 0.58$ (95% CI 0.21; 0.95), $p_{\text{adjusted}} = 0.007$), better quality of life ($\beta = 8.67$ (95% CI 4.96; 12.39), $p_{\text{adjusted}} < 0.001$), and less internalizing symptoms ($\beta = -9.64$ (95% CI -13.73; -5.56), $p_{\text{adjusted}} < 0.001$) (Table 3). Moreover, we found significant relations between playing mostly with family members, compared to playing alone, and life satisfaction ($\beta = 0.73$ (95% CI 0.35; 1.12), $p_{\text{adjusted}} < 0.001$), quality of life ($\beta = 7.14$ (95% CI 3.30; 10.99), $p_{\text{adjusted}} = 0.001$), and internalizing symptoms ($\beta = -11.41$ (95% CI -15.63; -7.19), $p_{\text{adjusted}} < 0.001$). Additionally, we discovered associations between playing outdoors, compared to playing mostly indoors, and better life satisfaction ($\beta = 0.45$ (95% CI 0.14; 0.75), $p_{\text{adjusted}} = 0.011$) and less internalizing symptoms ($\beta = -4.21$ (95% CI -7.62; -0.80), $p_{\text{adjusted}} = 0.037$). Furthermore, a larger difference score in how many days/week face-to-face was related to more internalizing symptoms ($\beta = 1.09$ (95% CI 0.21; 1.96), $p_{\text{adjusted}} = 0.037$). Other investigated relations are how many days/week face-to-face and how many days/week online (and the difference score) were not significantly related to mental well-being.

Table 1 Descriptive statistics of participants for the total group and separately for each age group (8–12 years and 13–18 years) during the pandemic

	Total	Age: 8–12 years	Age: 13–18 years	<i>p</i>
<i>n</i>	756	261	495	
Sex (%)				<0.001
Boy	295 (39.0)	128 (49.0)	167 (33.7)	
Girl	460 (60.8)	133 (51.0)	327 (66.1)	
Not disclosed	1 (0.1)	0 (0.0)	1 (0.2)	
Age (mean (SD))	13.7 (3.0)	10.1 (1.4)	15.5 (1.6)	<0.001
Patient group (%)				<0.001
General pediatrics*	383 (50.7)	95 (36.4)	288 (58.2)	
(Auto-)immune diseases†	161 (21.3)	62 (23.8)	99 (20.0)	
Cystic fibrosis	43 (5.7)	19 (7.3)	24 (4.8)	
Congenital heart disease‡	142 (18.8)	72 (27.6)	70 (14.1)	
Pediatric nephrology	27 (3.6)	13 (5.0)	14 (2.8)	
Educational level (%)				<0.001
Elementary school	127 (27.3)	125 (73.1)	2 (0.7)	
High school	246 (52.9)	28 (16.4)	218 (74.1)	
Vocational education	65 (14.0)	0 (0.0)	65 (22.1)	
Special education/other	27 (5.8)	18 (10.5)	9 (3.1)	
SES (mean (SD))	0.14 (0.18)	0.14 (0.19)	0.14 (0.18)	0.819
Families with 2 kids or more (%)	417 (86.0)	115 (89.1)	302 (84.8)	0.288
Child at home from school during completion of assessment due to restrictions (%)	31 (5.3)	15 (7.0)	16 (4.3)	0.222
Life satisfaction (Cantril Ladder of Life) (mean (SD))	6.52 (1.75)	7.11 (1.70)	6.21 (1.71)	<0.001
Quality of life (PedsQL-4.0-GCS-C) (mean (SD))	71.93 (17.62)	75.56 (16.51)	69.87 (17.92)	<0.001
Internalizing symptoms (RCADS) (mean (SD))	24.93 (19.15)	20.13 (16.53)	27.46 (19.95)	<0.001

*Children with persistent physical complaints

†Children diagnosed with for example juvenile idiopathic arthritis, inflammatory bowel disease, or primary immune deficiency

‡Children diagnosed with for example aortic arch anomalies, tetralogy of Fallot, or septum defects

Possible ranges of scores: SES: −7–3.1; life satisfaction: 1–10; quality of life: 0–100; internalizing symptoms: 0–141

SES socio-economic state, PedsQL-4.0-GCS-C PedsQL Generic Core Scale, RCADS Revised Child Anxiety and Depression Scale

Results from moderators with a significant interaction effect on the relation between play and life satisfaction, included the variables how the pandemic influenced leisure time of the child ($\beta = -0.18$ (95% CI $-0.34; -0.03$), $p = 0.023$), social support ($\beta = 0.05$ (95% CI $0.01; 0.08$), $p = 0.007$), and distress of the child ($\beta = 0.005$ (95% CI $0.000; 0.010$), $p = 0.046$) (Fig. 2).

Sensitivity analysis children with medically unexplained symptoms

We found comparable results for children with only MUS and no diagnosed somatic disorder ($n = 89$; mean age = 15.4 years (SD = 1.7)) to the age category 13–18 years. The association between with whom they mostly played and

life satisfaction was in the same direction but was less pronounced and not significant.

Discussion

We investigated the effects of social restriction, induced by the COVID-19 pandemic, on play behavior in children with a chronic physical condition, and the relation between play behavior and mental well-being. We observed variations in predominantly chosen playmates, frequency in social contacts (both face-to-face and online), and, notably for younger children, the predominantly selected location of play activities (inside or outside), comparing pre-pandemic conditions to those during the pandemic. Although initially, play activities seemed to diverge between the age categories of 8–12

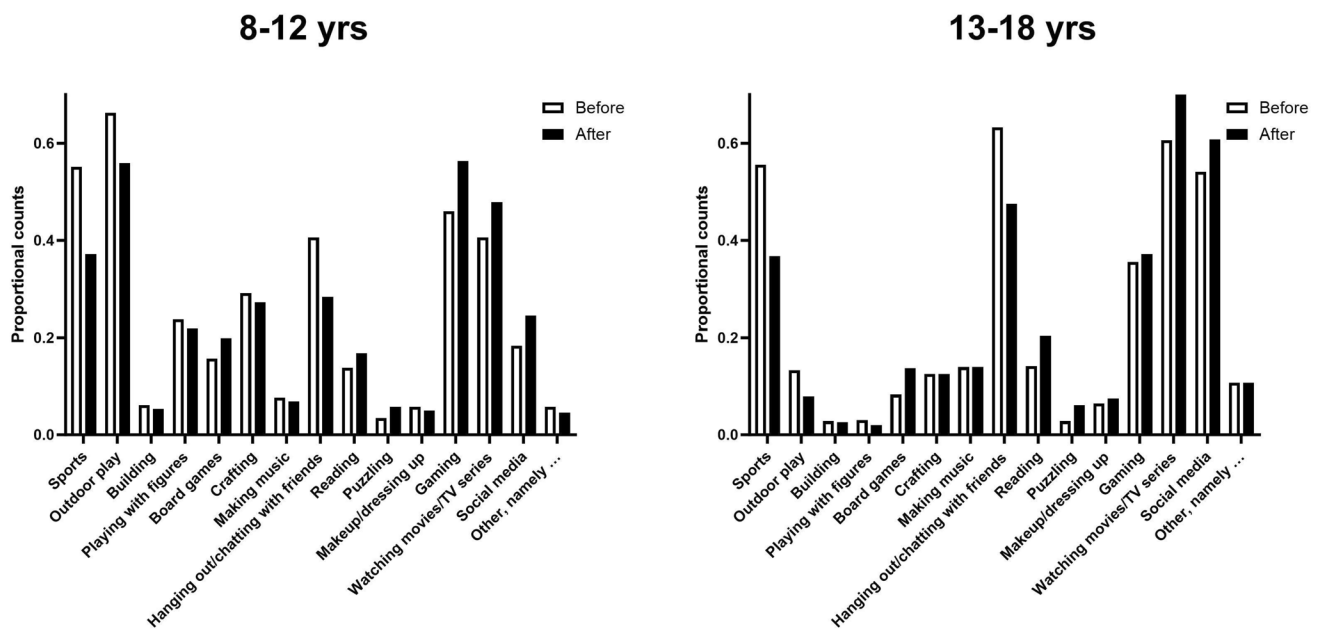


Fig. 1 Activities undertaken before and since the start of the pandemic, reported separately for the age categories 8–12 years and 13–18 years. The depicted values represent proportional counts of

responses to the question: “What do you mainly do/play in your free time (before and since the pandemic)?” Children were permitted to provide multiple answers

Table 2 Differences in play behavior between before and during the pandemic, separately for the age category 8–12 years and 13–18 years

Age: 8–12 years (n = 261)					
	Before pandemic	During pandemic	<i>p</i>	<i>P</i> _{adjusted}	
Who (n (%))					
Alone	15 (5.8)	23 (8.8)			
Friends	205 (78.5)	121 (46.4)			
Family	41 (15.7)	117 (44.8)	<0.001*	<0.001*	
Where (n (%))					
Inside	71 (27.2)	96 (36.8)			
Outside	190 (72.8)	165 (63.2)	<0.001*	0.002*	
How many days/week face-to-face (median (IQR))	3.0 (1.0; 3.0)	1.0 (0.5; 3.0)	<0.001*	<0.001*	
How many days/week online (median (IQR))	0.5 (0.0; 7.0)	3.0 (0.0; 7.0)	<0.001*	<0.001*	
Age: 13–18 years (n = 495)					
	Before pandemic	During pandemic	<i>p</i>	<i>P</i> _{adjusted}	
Who (n (%))					
Alone	71 (14.4)	121 (24.4)			
Friends	365 (73.7)	203 (41.0)			
Family	59 (11.9)	171 (34.6)	<0.001*	<0.001*	
Where (n (%))					
Inside	287 (58.0)	309 (62.4)			
Outside	208 (42.0)	186 (47.6)	0.053	0.112	
How many days/week face-to-face (median (IQR))	3.0 (0.5; 3.0)	0.5 (0.5; 3.0)	<0.001*	<0.001*	
How many days/week online (median (IQR))	7.0 (3.0; 7.0)	7.0 (7.0; 7.0)	<0.001*	<0.001*	

*Statistically significant result at $\alpha=0.05$

Table 3 Associations between play behavior and mental well-being

Age: 8–12 years (<i>n</i> = 261)												
Who	Estimate for life satisfaction (95% CI)	<i>p</i>	<i>P</i> _{adjusted}	Effect size partial <i>R</i> ²	Estimate for PedsQL-4.0-GCS-C (95% CI)	<i>p</i>	<i>P</i> _{adjusted}	Effect size partial <i>R</i> ²	Estimate for RCADS (95% CI)	<i>p</i>	<i>P</i> _{adjusted}	Effect size partial <i>R</i> ²
Alone	Reference				Reference				Reference			
Friends	0.76 (−0.01; 1.53)	0.05	0.11	0.018	14.40 (7.00; 21.80)	<0.001*	<0.001*	0.055	−12.32 (−19.67; −4.97)	0.001*	0.003*	0.045
Family	0.87 (0.10; 1.63)	20.028*	20.063		13.11 (5.72; 20.50)	<0.001*	<0.001*	0.002*	−12.82 (−20.20; −5.45)	<0.001*	0.002*	
Where												
Inside	Reference				Reference				Reference			
Outside	0.00 (−0.44; 0.45)	0.989	0.989	<0.001	1.90 (−2.50; 6.29)	0.396	0.566	0.003	−1.12 (−5.44; 3.19)	0.609	0.781	0.001
How many days/week face-to-face	0.07 (−0.03; 0.17)	0.192	0.331	0.006	1.62 (0.63; 2.60)	0.001*	0.004*	0.040	−0.69 (−1.67; 0.29)	0.167	0.299	0.007
How many days/week online	−0.00 (−0.08; 0.07)	0.924	0.962	<0.001	0.53 (−0.21; 1.28)	0.161	0.297	0.008	−0.25 (−0.98; 0.48)	0.493	0.655	0.002
Difference in how many days/week face-to-face	0.04 (−0.06; 0.14)	0.441	0.613	0.002	−0.10 (−1.17; 0.97)	0.851	0.946	<0.001	−0.10 (−1.11; 0.91)	0.843	0.946	<0.001
Difference in how many days/week online	−0.04 (−0.14; 0.05)	0.366	0.538	0.003	−0.43 (−1.34; 0.49)	0.361	0.538	0.003	0.20 (−0.71; 1.11)	0.664	0.830	<0.001
Age: 13–18 years (<i>n</i> = 495)												
Who	Estimate for life satisfaction (95% CI)	<i>p</i>	<i>P</i> _{adjusted}	Effect size partial <i>R</i> ²	Estimate for PedsQL-4.0-GCS-C (95% CI)	<i>p</i>	<i>P</i> _{adjusted}	Effect size partial <i>R</i> ²	Estimate for RCADS (95% CI)	<i>p</i>	<i>P</i> _{adjusted}	Effect size partial <i>R</i> ²
Alone	Reference				Reference				Reference			
Friends	0.58 (0.21; 0.95)	0.002*	0.007*	0.028	8.67 (4.96; 12.39)	<0.001*	<0.001*	0.038	−9.64 (−13.73; −5.56)	<0.001*	<0.001*	0.052
Family	0.73 (0.35; 1.12)	<0.001*	<0.001*		7.14 (3.30; 10.99)	<0.001*	<0.001*	0.001*	−11.41 (−15.63; −7.19)	<0.001*	<0.001*	

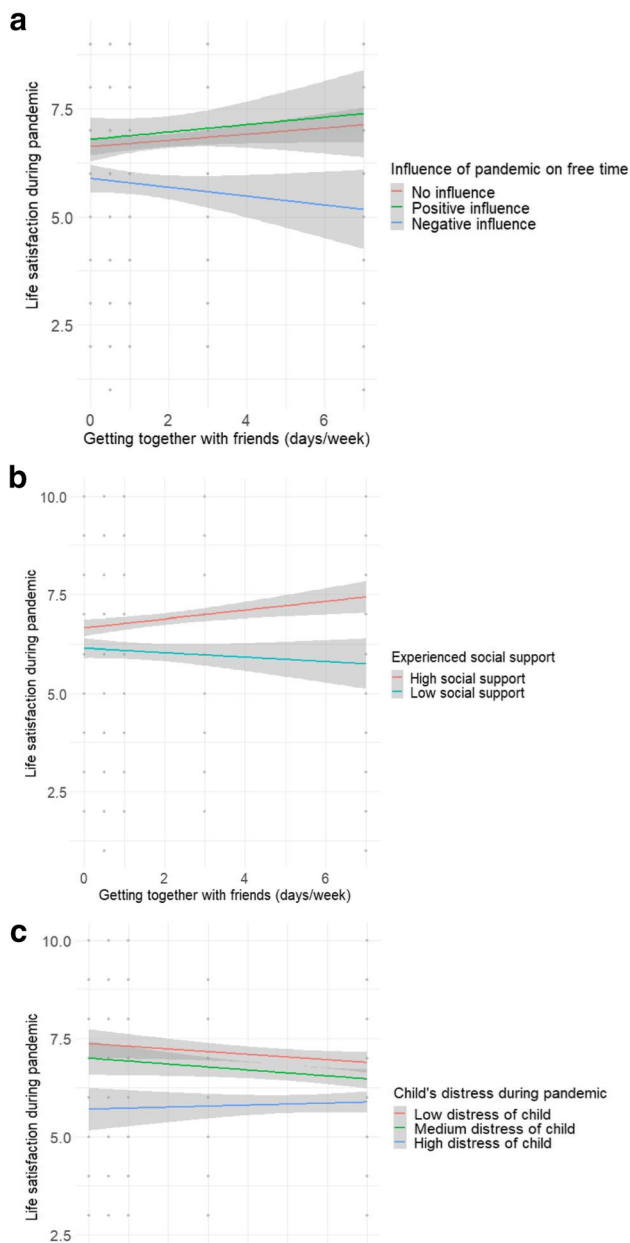


Fig. 2 Significant moderation analyses for the moderators influence of the pandemic (a), social support (b), and distress of the child (c). A single asterisk (*) indicates that, for visualization purposes, the variable social support was split into two groups using a median split and the variable distress of the child was split into three groups based on tertile cuts. Furthermore, the figures do not incorporate the potential effects of covariates

years and 13–18 years, supporting our choice to consider these age groups separately in our analyses. However, the impact of the pandemic on play activities exhibited a similar pattern across both age groups: physical, outdoor, and social play activities appeared to decrease, while solitary and indoor activities tended to increase. For the associations between play behavior and mental well-being, playing with

friends or family members, compared to playing alone, was positively associated with mental well-being (life satisfaction, quality of life, and less internalizing problems). Moreover, for children between 13 and 18 years, we observed associations between the location of playing (outside vs. inside) and mental well-being (higher life satisfaction and less internalizing symptoms). With exploratory analyses, we found that several factors may influence the associations between play behavior and mental well-being: for children with a negative attitude towards the effects of the pandemic on play behavior and low experienced social support, a higher rate of getting together with friends seemed to result in poorer life satisfaction. Moreover, for children experiencing higher rates of distress chatting with friends seemed to help to improve life satisfaction. We can only speculate here what these findings may mean for children with a chronic illness, but the former finding may suggest that children who perceive their condition/situation more negative may not benefit from social contact as children who perceive their condition/situation as positive or at least less negative. These findings are interesting in the light of previous observations which suggest that perceiving oneself as chronically ill was associated with impaired psychosocial functioning [22]. In a wider scope, there is evidence that perceived threat may be a better predictor for PTSD symptoms than actual exposure to combat, for example, seen in reference [36]. Taken together, these findings emphasize the need to compare objective and perceived chronic illness in relation to mental health in children. By contrast, children who suffer higher rates of distress seem to benefit from contact with friends. During adolescence, peer contact is increasingly important. Social relationships are especially rewarding during adolescence, and there is increasing evidence for the importance of peer contact, for the development of resilience for instance [37]. The current findings corroborate with these results and suggest that playing with peers helps to relieve stress and anxiety.

Restrictive measures were induced during the COVID-19 pandemic. In normal circumstances, it is difficult to investigate the effects of social restrictions on (play) behavior in children. However, the COVID-19 pandemic provided the opportunity to investigate the effects of (social) play restrictions on mental well-being. In the current study, we indeed observed that the pandemic resulted in changes in play behavior.

From animal research, it is clear that several factors of isolation can impact development and behavior later in life [19, 20]. In the short term, play is rewarding and motivating [38]; while in the long run, the opportunity to take risks and social play (restrictions) can affect adult behavior and cognitive functioning [39, 40]. Outdoor play in children may provide more opportunities for risk-taking behavior than indoor play. In the current study, we did not uncover a

clear association between the location (inside vs. outside) and mental well-being in the younger age group but did observe a positive association between playing outside and mental well-being in the older age group (13–18 years). Furthermore, for all ages, we observed an association between predominantly chosen playmates and mental well-being. This indicates that social play has a more positive effect on mental well-being than solitary play. During the pandemic unfortunately, the predominantly chosen play activities seemed to be more often solitary than before the pandemic. However, is not only engaging in play with friends, which was often restricted, but also participating in activities with family members that demonstrate a positive association with a mental well-being. It should be noted, however, that the effects of play on mental well-being investigated in the current study may have been short-term and long-term implications that remain uncertain.

The effects of social restrictions on play behavior in relation to mental well-being were investigated in a vulnerable group of children, i.e., children with a chronic physical condition, and only during the pandemic. Additionally, the relation of play behavior and mental well-being outside of the context of the COVID-19 pandemic is not investigated in the current study, and there is little data available regarding the “typical” play behaviors in these children. Based on existing literature, it is, however, likely that children with chronic conditions face unique challenges that hamper them in their opportunities to engage in play due to factors like physical limitations and psychosocial stressors [11]. Although we did not assess the effects of COVID-19 restrictions on play behavior and the association with mental well-being in healthy children, other studies have shown that also in otherwise healthy children the pandemic has led to reductions in play [13–16], and this was related to children’s mental well-being [17, 18]. Moreover, the results of a previous study within the PROactivecohort suggested that although mental well-being was poorer for children with a chronic physical condition pre-pandemic, the impact of the pandemic on their mental well-being was comparable to that observed in a cohort of healthy children [26].

Some limitations of the current research are worth mentioning. Social restrictions were induced by the COVID-19 pandemic and results might therefore not generalize to the effects of other causes of play restrictions, such as hospitalization or war. Although this was not the focus of this study, the size of the dataset would not have allowed us to make further subdivisions in disease groups, but it would be interesting to investigate the relation between play and well-being between groups of children that suffer from different diseases. It is plausible that there may be differences between such groups but also between children with a congenital versus acquired disease or between diseases associated with more restrictions versus diseases that are “not obvious” to

lead to restrictions in daily life. In general, it is good to realize that diseases can be treated increasingly better, so the huge differences between the various diseases with regard to prognosis and outcomes are becoming smaller [11, 25, 41]. This is an important reason to assume that it probably matters more that a child has a chronic disease than exactly which disease the child has. On the other hand, our cohort composition is a major strength of the study. We included children with different chronic physical conditions, and our sensitivity analysis including only children with persistent physical complaints showed that results are roughly comparable to the results in other disease groups. This indicates that the effects of the pandemic on play behavior, and the relation with mental well-being, may not be disease-specific.

Play behavior during early childhood may influence mental well-being in early adolescence [23]. Therefore, play behavior might be crucial in developing resilience [11]. This is true for children with a chronic disease, but also for healthy children [17, 42, 43]. Future research should concentrate on investigating the long-term effects of changes in play behavior on mental well-being in children with a chronic physical condition, as the current study is limited to immediate effects. Furthermore, we propose to develop generic patient- (and parent-) reported outcome measures. This could facilitate research on the topic of play behavior in children, potentially serving as a valuable avenue for early problem detection and intervention to mitigate mental health issues later in life.

In conclusion, the COVID-19 pandemic has induced changes in play behavior in children with a chronic physical condition. Mainly playing with others (friends and family members) seemed to have a positive effect on mental well-being. These findings highlight the importance of the relation between play (behavior) and mental well-being, especially in children who are at increased risk of lowered mental well-being, such as children with chronic illnesses. Playing is “normal” behavior that belongs to “normal” development and stimulating “normal” behavior for a better outcome of mental well-being is incredibly important for all and in particular vulnerable children, such as children with a chronic disease. By being alert to providing “sufficient” play behaviour, problems with mental well-being may be prevented and resilience may be supported. The implication of this study could therefore be that we should aim for creating more awareness among care providers that, besides treatment of the (consequences of) chronic disease, it is also important to pay attention to preventing problems by, for instance, stimulating play behaviour.

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Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

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Competing interests The authors declare no competing interests.

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