


**Research Article**

## The Wellbeing of Children and Workers in Belgian French-Speaking Primary Schools After The COVID-19 Pandemic Crisis

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### Abstract

During the COVID-19 pandemic crisis, many measures were taken around the world to limit the SARS-CoV-2 transmission that disrupted people's day-to-day lives in many ways. Unfortunately, most of these measures had detrimental consequences, such as isolation, misinformation, fear, and violence, inducing a loss of wellbeing for many people. One of the most vulnerable groups to these pandemic consequences was children. We conducted a study to assess children and staff wellbeing in French-speaking primary schools in Belgium after the COVID-19 pandemic crisis. A 37-question questionnaire based on the Revised Children's Manifest Anxiety Scale (RCMAS) was used for each child and a 14-question questionnaire based on the Hospital Anxiety and Depression scale (HAD) was used for each staff to assess their wellbeing. The three-drawing method was used to assess children's representation of wellbeing before, during, and after the COVID-19 pandemic, respectively.

A total of 282 children and 33 staff answered the wellbeing questionnaire. 63% of children (174/276) had symptoms of anxiety, and 38% (104/282) had a definite state of anxiety. 65% of children (178/276) had symptoms of social desirability, and 55% (151/276) had a definite state of social desirability. The wellbeing representation was impacted by the COVID-19 pandemic during and after the pandemic. Very few staff accepted to participate in the study. A total of 102 children created drawings. The representation of children's wellbeing in their drawings showed that the pandemic had had an impact on their life, which was reflected in different ways in the drawings during the pandemic, such as isolation, negative content, negative facial expressions, or sadness. After the COVID-19 pandemic crisis, the wellbeing of children remained affected; anxiety was still as high as it was during the COVID-19 pandemic crisis. Particular attention must be devoted to children as a vulnerable group, to avoid consequences in the long term.

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### Introduction

During the COVID-19 pandemic crisis, many measures were taken around the world to limit the transmission of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which disrupted the daily lives of people in many ways. The interruption of social activities, social distancing, confinement, curfews, and mask policies were measures taken to limit the transmission of the virus. Unfortunately, all these measures have had harmful consequences, such as isolation, misinformation, fear, and violence, which have affected

the wellbeing of many people. One of the most vulnerable groups to these consequences of this pandemic was children. In 2019, the WHO (World Health Organization) estimated 301 million people worldwide were suffering from anxiety and 280 million from depressive disorders [1]. In 2020, a study conducted in 204 countries and territories showed that 298 million people had suffered from anxiety disorders and 193 million from depressive disorders. After adjusting for the COVID-19 pandemic, 374 million people were affected by anxiety disorders and 246 million by depressive disorders. Between the two years, there was an increase of 26% and 28% respectively. The increase was greater among women than among men, and prevalence also showed a more marked change in younger groups, that might reflect an impact of social restrictions and school closures [2]. Results in China also showed that anxiety and depression levels in children and adolescents increased during the COVID-19 pandemic crisis [3].

School closures, lockdowns, isolation, fear, and interruption of social activities had an important impact on the development of children. In the past, school closures have shown that pupils who have been absent for a long period were more likely not to return when schools reopened. In addition, previous health crises have shown that children are at a greater risk of violence and abuse [4]. Several studies have shown that the physical, mental, and social wellbeing of children were affected by interrupted reactional activities and the closure of schools [5–7]. The pandemic has reinforced social inequalities among disadvantaged backgrounds [8]. It also led to economic instability, and the wellbeing of children appeared to deteriorate as the economy declined [9, 10]. Long-term effects shouldn't be underestimated. A study in the USA on the different effects of historical pandemics on children showed that almost a third of them suffered from symptoms of post-traumatic disorder [11]. A systematic review of the impact of social isolation on the mental health of children showed a direct association between social isolation and mental health, resulting in future mental health problems even up to 9 years later [12]. In Belgium, primary schools were not closed during the COVID-19 pandemic crisis. However, the interdiction of reactional activities, physical distances, and limitation of social contacts were maintained to limit the transmission of the virus. In a study conducted in primary schools during the COVID-19 pandemic crisis at the beginning of 2021 during the lockdown period, 53% of children expressed symptoms of anxiety and 31% were anxious [13]. As wellbeing is an evolving state, and keeping in mind the many emerging consequences of the pandemic, the monitoring of the wellbeing after the COVID-19 pandemic remains essential, particularly in children, knowing that anxiety problems can persist into adulthood and evolved to serious health problems. We conducted the present study to assess the wellbeing of children in French-speaking primary

schools in Belgium after the COVID-19 pandemic crisis. We aimed to learn lessons for future health crises and to help professional decision-makers take measures to protect the development of children.

## Methods

We conducted a first study DYNAtacs, DYNAMIC TRANSMISSION OF CORONAVIRUS IN SCHOOLS, from January 14 to May 18, 2021, in 11 primary schools of the Federation Wallonia-Brussels in Belgium. Schools were selected using a purposive sampling based on the extremes of three inclusion criteria. The first criterion was the local incidence level of SARS-CoV-2 during the first wave on May 6<sup>th</sup>, 2020 in Belgium [14]. Schools with a local cumulative incidence below 5.0 cases per 1,000 persons were considered as a locally low incidence of SARS-CoV-2. Schools with a local cumulative incidence equal to or greater than 5.0 cases per 1,000 persons were considered as a locally high incidence level of SARS-CoV-2. The second criterion was the size of the school which ranges between 12 and 600 pupils in Belgium [15]. Schools with less than 230 children were considered as small and as large if above 230.

The third criterion was based on the school's socioeconomic status (SES). SES is a national scale qualifying all French-speaking schools in Belgium [16]. SES is a 20-point index based on 7 data of the child's household over 7 years: the household income, the number of persons with a superior education degree, the number of persons with a nursery or primary degree, the number of persons with a job, the number of persons with social assistance, the number of persons with a manual job and the number of persons with a job in the lowest level of the tertiary sector. Individual values are collected from each child. For this criterion, schools with a SES lower than 7 were considered as low and those with a SES above 13 were considered as high. Schools were selected within each of the eight categories defined by crossing the two levels of the three criteria. The full study design is described in more detail in previous publications related to DYNAtacs [13, 17, 18]. In each school, participants were tested using a rapid serological test by finger prick on the inclusion day and then followed with at least 6 visits over at least 6 weeks. A saliva antigen test of SARS-CoV-2 was performed at each visit. Results are reported in other publications [17, 18]. The wellbeing of children was also assessed and results were reported in another publication [13]. We went back to the same schools after the COVID-19 pandemic crisis to analyze the wellbeing of children and workers, between March 14<sup>th</sup> and April 13<sup>th</sup>, 2023. We invited children to answer a paper-format questionnaire using the Revised Children's Manifest Scale (RCMAS). Children in 3<sup>rd</sup> (8 years old) and 6<sup>th</sup> grade (12 years old) were also asked to produce 3 drawings of themselves and their school before, during, and after the COVID-19 pandemic.

### Revised Children’s Manifest Scale

RCMAS is a scale based on 37 questions (Table 1) with “Yes” or “No” as an answer, coded as 1 or 0, respectively. A total anxiety score is then calculated using 28 items. The total anxiety dimension is the sum of answers to the 28 items, ranging from 0 to 28. A score lower than 10 is defined as an absence or minimum of anxiety symptoms, between 11 and 13 it is defined as an anxious state, and a score equal to or higher than 14 is defined as a definite anxious state.

From these 28 items, three anxiety subscales are also calculated, (1) physiological manifestations, based on 10 items, (2) worry and hypersensitivity, based on 11 items, (3) concentration and social anxiety, based on 7 items. The first dimension, physiological manifestations, refers to difficulties in falling asleep, fatigue, and nausea. The physiological manifestations dimension is the sum of responses to the 10 corresponding items. The score ranges from 0 to 10. A score lower or equal to 3 is defined as an absence or minimum physiological manifestation, a score higher than 4 suggests physiological manifestations, and a score of at least 5 corresponds to a definite state of physiological manifestations. The second dimension, worry, and hypersensitivity, refers to mental ruminations linked to emotional injury and fear of isolation fear. The worry and hypersensitivity dimension is the sum of responses to the 11 corresponding items. It ranges from 0 to 11. A score below 4 is defined as an absence or minimum of worry and hypersensitivity, a score of 5 suggests symptoms of worry and hypersensitivity and a score of 6 or more corresponds to a definite state of worry and hypersensitivity.

The third dimension, concentration, and social anxiety, relates to problems at school. The concentration and

social anxiety dimension is the sum of responses to the 7 corresponding items, ranging from 0 to 7. A score under 2 is defined as an absence or minimal difficulties with concentration and social anxiety, a score of 3 suggests difficulties with concentration and social anxiety, and a score of 4 or more corresponds to a definite state with difficulties with concentration and social anxiety. The remaining 9 items are used in a fourth dimension to estimate the social desirability. The social desirability score is the sum of responses to the 9 remaining items. This score has a minimum of 0 and a maximum of 9. A score under 3 is defined as an absence or low social desirability, a score above 4 is defined as a social desirability suspicion, and a score equal to or greater than 5 is defined as a definite state of social desirability [19, 20]. Social desirability corresponds to the desire to answer questions according to what the respondent thinks is most favorable about the interviewers, to make a good impression. For example, one of the questions is “I never lie”. If the child answers “Yes”, even though everyone lies, it means that he or she is trying to make himself or herself look good.

### Hospital Anxiety and Depression scale

The adult questionnaire included 14 questions based on the Hospital Anxiety and Depression scale (HAD) (Table 1) to assess staff wellbeing. The HAD scale refers to symptoms of anxiety and depression using 7 questions for each dimension. Each question has a 4-point response with a value from 0 to 3. A total anxiety score and a total depression score can be calculated with a maximum of 21 points each. A score lower or equal to 7 is defined as an absence of anxiety or depression, a score between 8 and 10 is defined as a suspected state of anxiety or depression, and a score equal to or greater than 11 is defined as a definite state of anxiety or depression [21].

Table 1: Wellbeing scales

	Range	Absence	Presence	
			Suspicion state	Definite state
<b>Children</b>				
RCMAS (37 questions 0-1)				
Anxiety	0-28	≤ 9	10-13	≥ 14
Physiological manifestations	0-10	≤ 3	4	≥ 5
Worry and hypersensitivity	0-11	≤ 4	5	≥ 6
Concentration and social anxiety	0-7	≤ 2	3	≥ 4
Social desirability	0-9	≤ 3	4	≥ 5
<b>Adults</b>				
HAD (14 questions 0-3)				
Anxiety	0-21	≤ 7	8-10	≥ 11
Depression	0-21	≤ 7	8-10	≥ 11
RCMAS: Revised children's manifest anxiety scale; HAD: Hospital anxiety and depression				

## Drawings

Each child in 3<sup>rd</sup> and 6<sup>th</sup> grade was asked to make 3 drawings in addition to the wellbeing questionnaire. We adopted the 3-drawing method to analyze the representation of children’s wellbeing in the school environment before, during, and after the pandemic of COVID-19 [22]. We provided sheets with a box where each child was invited to draw his or her school and him or herself before, during, and after the COVID-19 pandemic. Beyond these instructions, the child could add whatever he or she wished to draw. We provided a box of colored pencils for the children to use while they produced their drawings. To interpret the drawings, we adapted the scale used in the 3-drawing method, and the adapted scale used in a study on the representation of lockdown in children before, during, and after the COVID-19 pandemic [22, 23]. Drawings were analyzed with a personalized scale concerning the school, wellbeing, and the COVID-19 pandemic (Table 2). To ensure that the drawings can be interpreted as accurately as possible, each drawing has been analyzed and briefly described to retain as much information as possible.

## Statistical Analysis

### RCMAS and HAD scores

As the present study took place after the COVID-19 pandemic crisis period, there was no evident matching with the sample of the first study. Results are reported as mean ± standard deviation (SD) for continuous variables and numbers with proportion for categorical variables. Student’s t-test and analysis of variance (ANOVA) with F-test were used to compare subgroups. Correlations between RCMAS scores were assessed using Pearson’s correlation coefficient *r*. Prevalence based on RCMAS scores during the COVID-19 pandemic crisis and after were compared using the chi-square tests. A comparison of RCMAS anxiety and social desirability scores between the first study and the second study was performed using only children who participated in both studies. The scatter plot was used to represent the changes over the two periods in the anxiety score and in the social desirability score.

**Table 2:** Scale drawings adapted scale to wellbeing before, during, and after the COVID-19 pandemic

Content		Coding	Description
Expressive content(s)	Positive facial expression	0=absence/1=presence	Open eyes, smiling faces, laugh
	Positive content	0=absence/1=presence	Sun, flowers, rainbows, butterfly, birds, stars, animals.
	Negative facial expression	0=absence/1=presence	Sad, tears, isolation, angry, fears
	Negative contents	0=absence/1=presence	Clouds, rain, thunder, broken objects,
	Movements	0=absence/1=presence	Body in movements?
	Items classification		
	COVID-19 references	0=absence/1=presence	People wearing masks, confinement, isolation, test positive, sick, virus
	School references	0=absence/1=presence	Teachers, schools, recreation
	Child itself	0=absence/1=presence	Represents him/herself
	Friends	0=absence/1=presence	Represents friend(s)
	Parents	0=absence/1=presence	Represents parent(s)
	Family	0=absence/1=presence	Represents family
	House	0=absence/1=presence	Represents the house
Structure			
	Colours	Numbers	Use others colours than black and how many
	People	Numbers	How many
	Elements related to COVID-19	Numbers	How many
	Elements related to wellbeing	Numbers	How many
	Use of different sizes	Numbers	How many
	School	Characters	How is the structure of the school?



## Drawings

Differences between items on the drawing scale over the three periods (before, during, and after the pandemic) were assessed using the McNemar test. The statistical significance level was set to 0.05. Data were analysed with R 4.2.2.

## Study population and inclusion criteria

All children and staff in previously selected primary schools were invited to participate. Participants were included if the consent was signed by both parents and the child or by the staff.

## Exclusion criteria

Absence or refusal to provide written informed consent before enrolment.

## Data collection

Human data were collected following the Declaration of Helsinki. The protocol, informed consent forms, and questionnaires were approved by the Hospital-Faculty Ethics Committee Saint-Luc (“Commission d’Ethique hospitalo -facultaire des Cliniques universitaires Saint-Luc”) – UCLouvain, approval number: 2022/06DEC/469. The study investigators visited each school and interviewed each participant. Every questionnaire was in paper format. Each response to the questionnaires was encoded in a double database and each data was encoded in an anonymized way. A verification of the double encoding was carried out. The database was then converted into an Excel file.

## Results

Of the 11 schools selected for the primary study, two were excluded because their principals refused to participate. Among the 9 remaining schools, 13% of children (282/2247) and 10% of staff (33/346) participated in the study giving back a signed consent form.

## Revised Children’s Manifest Anxiety Scale

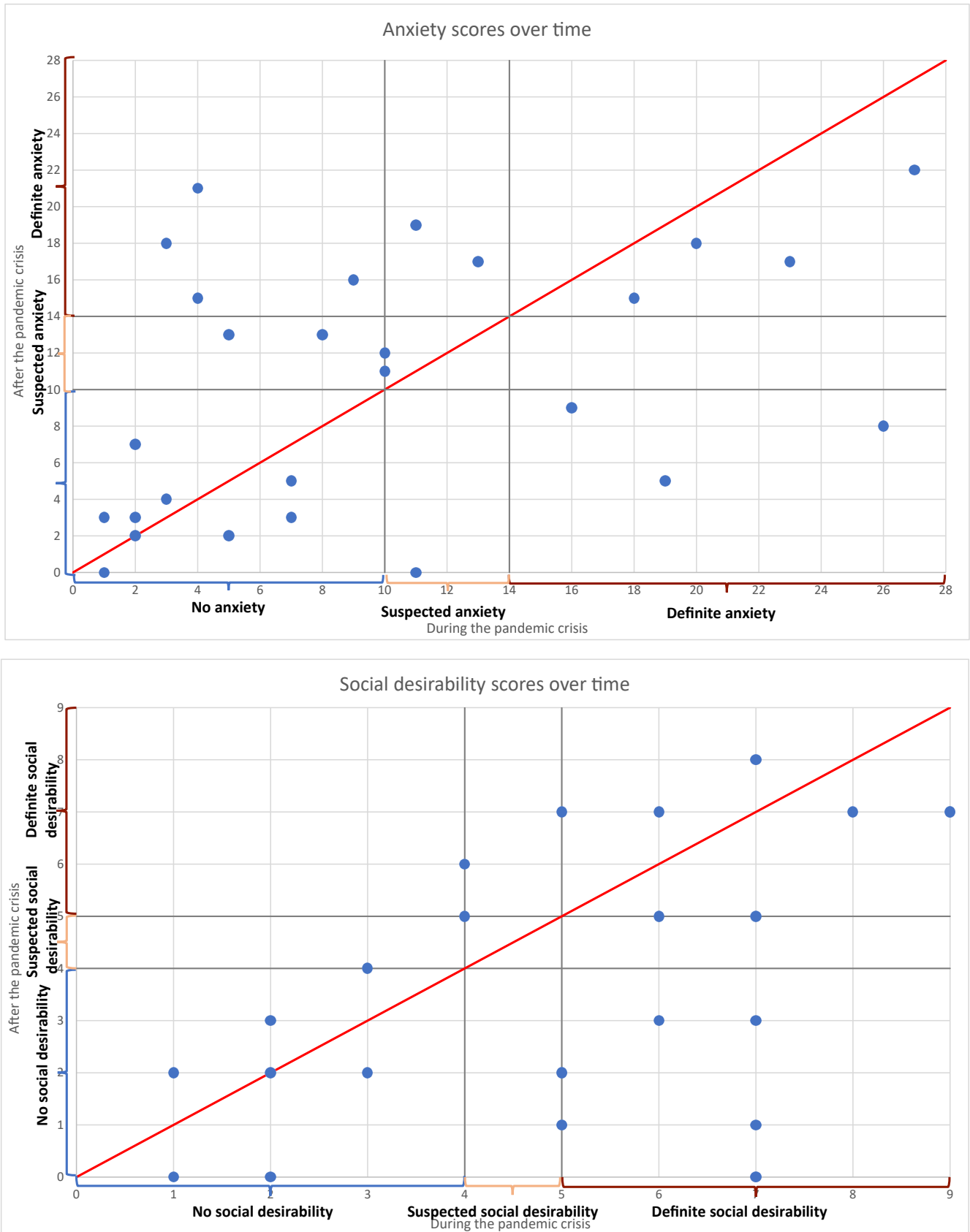
The wellbeing questionnaire was completed by 98% (276/282). The mean age was  $9.0 \pm 1.7$  years and 59% (164/276) were girls. After the pandemic crisis, 63% of children (174/276) had symptoms of anxiety, and 38% (104/276) had a definite state of anxiety. During the COVID-19 pandemic crisis, symptoms of anxiety were observed in 53% of children (122/231), and a definite state of anxiety was observed in 31% of children (72/231). The increase in the prevalence of anxiety symptoms was significant ( $p$ -value=0.03). Girls had a higher anxiety score compared to boys ( $12.2 \pm 6.0$  versus  $10.6 \pm 5.5$ ;  $p$ -value=0.02). Social desirability scores were still high after the COVID-19 pandemic crisis, with 65% of children (178/276) with symptoms of social desirability and 55% (151/276) having a definite state of social desirability. Similar results were found during the COVID-19 pandemic

crisis, with 65% of children (150/231) having symptoms of social desirability, and 52% (120/231) having a definite state of social desirability. Youngest children had a higher RCMAS social desirability score (6-7 years:  $5.2 \pm 2.2$ ) than older children (8-9 years:  $4.6 \pm 2.7$ ; 10-12 years:  $4.2 \pm 2.4$ ;  $p$ -value=0.02). Higher social desirability correlated with lower anxiety scores ( $r$ =-0.31; 95% CI [-0.41;-0.20]). Symptoms of physiological manifestations were observed in 67% of children (184/276), and a definite state in 53% (145/276) after the pandemic crisis. Compared to 49% of children (114/231) and 36% of children (82/231) during the pandemic crisis, the two increases in prevalence were significant ( $p$ -value<0.001, and  $p$ -value<0.001, respectively). Symptoms of worry and hypersensitivity were observed in 54% of children (148/276), and 42% (115/276) had a definite state of worry and hypersensitivity. Similar results were observed during the pandemic crisis, with 46% (107/231) showing symptoms of worry and hypersensitivity, and 37% (86/231) showing a definite state of worry and hypersensitivity. Symptoms of concentration difficulties and social anxiety were observed in 39% of children (108/276) had, and a definite state in 24% (66/276) after the pandemic crisis. Similar results were observed during the pandemic crisis, with 36% (82/231) having symptoms of concentration difficulties and social anxiety, and 20% (47/231) having a definite state of concentration difficulties and social anxiety.

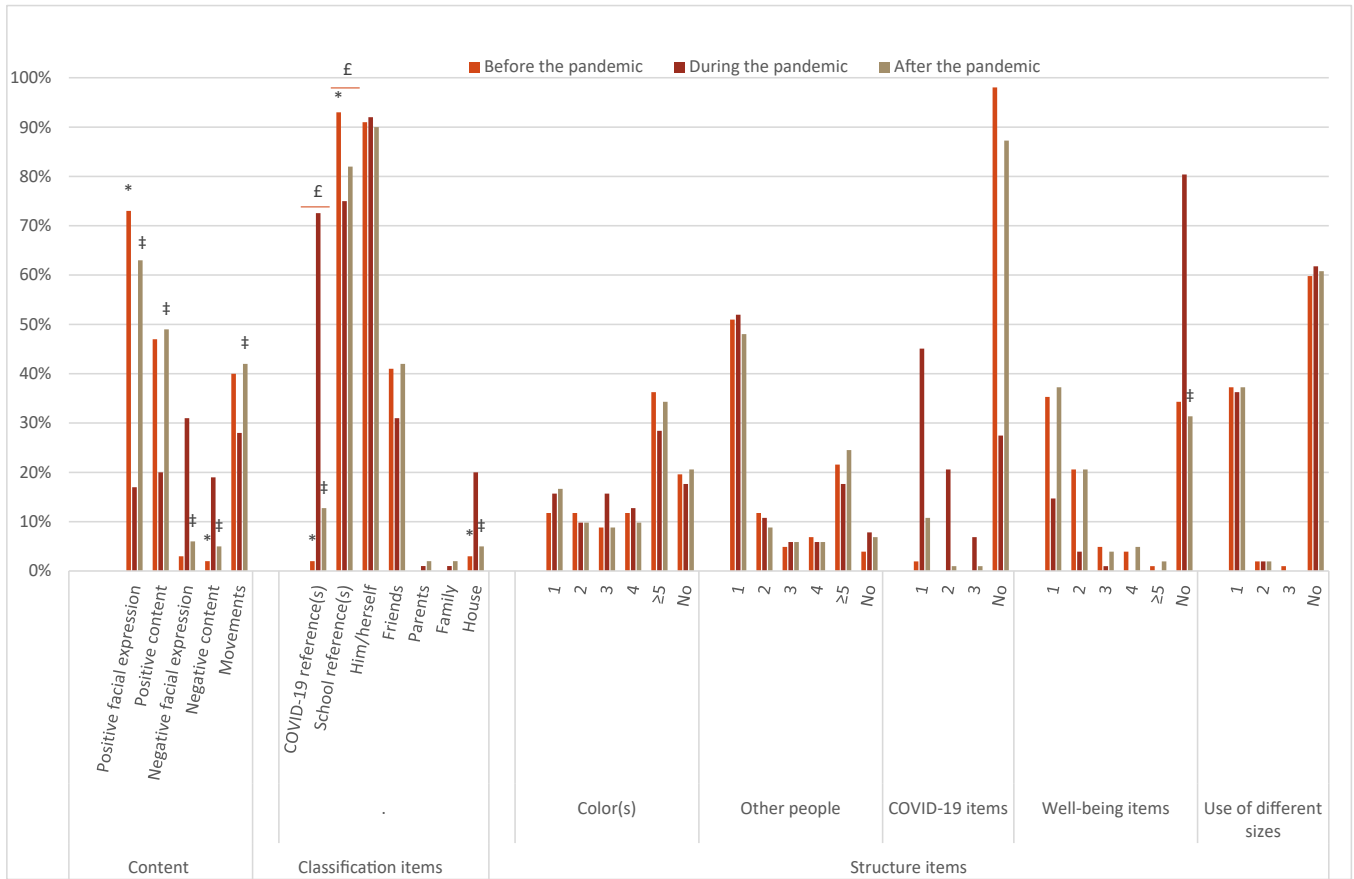
**Table 3:** Prevalences in complete sample and matched subset over time

		Complete sample		Matched subset	
		During	After	During	After
		n=231	n=276	n=27	
Anxiety	≥ 10	53%	63%	44%	52%
	≥ 14	31%	38%	26%	37%
Social	≥ 4	65%	64%	74%	44%
desirability	≥ 5	52%	55%	67%	41%

VA total of 27 children completed the wellbeing questionnaires in the first study and in the present study. In this matched subset the prevalence of anxiety symptoms increased from 44% of children during the COVID-19 pandemic crisis to 52% of children after the COVID-19 pandemic crisis, and the prevalence of a defined anxiety state increased from 26% to 37% after the pandemic crisis. Suspected social desirability decreased from 74% to 44% after the pandemic crisis. The defined social desirability state also decreased from 67% to 41% after the pandemic crisis. Anxiety during the COVID-19 pandemic crisis and anxiety after the COVID-19 pandemic crisis are shown in Table 3 and on Figure 1.



**Figure 1:** Representation of anxiety and social desirability for the matched subset over time



**Figure 2:** Drawings contents  
p-value significant <0.05: \* before versus during; £ before versus after; ‡ during versus after

### Hospital Anxiety and Depression scale

The questionnaire was completed by 94% of staff (31/33). The mean age was 44.4 ± 12.0 years, and 84% (26/31) were women. There were 65% of teachers (20/31), 13% of directors (4/31), 13% of caretakers (4/31), 7% of secretaries (2/31), and 3% were childcare workers (1/31). Symptoms of anxiety was 42% of staff (13/31), and 16% (5/31) had a definite anxiety state after the pandemic crisis. Similar results were assessed during the pandemic crisis, with symptoms of anxiety in 42% (92/221), and 16% (35/221) had a definite state of anxiety. Symptoms of depression were present in 13% of staff (4/31), and 7% (2/31) had a definite state of depression after the pandemic crisis. Similar results were observed during the pandemic crisis, with 13% of staff (29/221) with symptoms of depression, and 5% (12/221) with a definite depression state.

### Drawings

A total of 102 children produced drawings, of whom 67% were girls (68/102) and 83% (85/102) reported that they liked the drawing. The longest time taken to complete the drawings was 1 hour and 26 minutes. Contents are presented on Figure 2.

### Expression content

#### Positive facial expression

Representations of facial expression by children were 73% (74/102) before, 17% (17/102) during, and 63% (64/102) after the COVID-19 pandemic. The proportion during the COVID-19 pandemic was significantly lower than before (p-value<0.001), and then after (p-value<0.001).

#### Positive content

The representation of positive content in children’s drawings was 47% (48/102) before, 20% (20/102) during, and 49% (50/102) after the COVID-19 pandemic. The lowest positive content observed during the COVID-19 pandemic was significant compared to after (p-value=0.004).

#### Negative facial expression

The representation of negative facial expressions in children’s drawings showed an opposite trend, with 3% (3/102) before, 31% (32/102) during, and 6% (6/102) after the COVID-19 pandemic. The representation of negative facial expressions was higher during the COVID-19 pandemic compared to after (p-value=0.004).

## Negative content

The representation of negative content in children's drawings showed also an opposite trend, with 2% (2/102) before, 19% (19/102) during, and 5% (5/102) after the COVID-19 pandemic. The representation of negative content was higher during the COVID-19 pandemic compared to before ( $p$ -value<0.001) and after ( $p$ -value=0.006).

## Movements

Movement representation in children's drawings showed also an opposite trend, with 40% (41/102) before, and a significant increase from 28% (29/102) during the COVID-19 pandemic compared to 42% (43/102) after the COVID-19 pandemic ( $p$ -value=0.03).

## Classification items

### COVID-19 references

The representation of references to COVID-19 in children's drawings was 2% (2/102) for the period before the COVID-19 pandemic.

In general, COVID-19 elements were present in almost all the drawings for the pandemic time. Children represented at least one element of the COVID-19 pandemic in 73% of drawings (74/102), such as face masks, distance, school or governmental measures, closed schools, houses, hydro-alcoholic gel, etc. After the pandemic, 13% of children (13/102) kept items related to the COVID-19 pandemic in their drawings. The representation of COVID-19 references was higher during ( $p$ -value<0.001) and after COVID-19 ( $p$ -value=0.009) compared to before. The representation of COVID-19 was also higher during COVID-19 compared to after the pandemic ( $p$ -value<0.001).

### School references

The representation of a school in children's drawings was 93% (95/102) before, 75% (76/102) during, and 82% (84/102) after the COVID-19 pandemic. The representation of the school was higher before the COVID-19 pandemic compared to the other periods ( $p$ -value<0.001, and  $p$ -value=0.006).

### Self-representation

Self-representation in children's drawings was unchanged, with 91% (93/102) before, 92% (94/102) during, and 90% (92/102) after the COVID-19 pandemic.

### Friends

The representation of friends in children's drawings had also a V shape across time, with 41% (42/102) before, 31% (32/102) during, and 42% (43/102) after the COVID-19 pandemic.

### The house

The representation of home in children's drawings was

only 3% (3/102) before; it increased to 20% (20/102) during the pandemic, and returned to 5% (5/102) after the COVID-19 pandemic.

## Structure items

### Color(s)

The use of color(s) has been represented in 80% of children's drawings (82/102) before the pandemic, 82% (84/102) during the pandemic, and 79% (81/102) after the pandemic. Before the pandemic, 36% of them (37/102) used at least 5 different colors. During the COVID-19 pandemic, this proportion fell to 28% of them (29/102), and it went back to 34% (35/102) in drawings for after the pandemic.

### Other persons

The representations of person(s) were used in 96% of children's drawings (98/102) before the pandemic. Similar proportions were reported for the other periods.

### COVID-19 item(s)

The representation of a COVID-19 element in children's drawings was 2% (2/102) before the COVID-19 pandemic. It increased to 73% (74/102) for the pandemic period, but it remained at 13% (13/102) for the post-pandemic time.

### Wellbeing item(s)

The representations of wellbeing element(s) were 66% in children's drawings (67/102) before the pandemic. This proportion fell drastically to 20% during the pandemic and went back to 69% after the pandemic. The representation of wellbeing items was lower during the COVID-19 pandemic compared to after the pandemic ( $p$ -value<0.001).

### Size

The representation of different sizes in drawing elements over the period in the children's drawings was 40% (41/102) before, 38% (39/102) during, and 39% (40/102) after the COVID-19 pandemic.

## Some particularities in drawings deserved attention

One child remembered the previous study and represented the survey team in his drawings (see supplementary material N°1). Some children drew items associated with sadness (tears, sad faces, clouds, dark colors) and items associated with joy (butterflies, flowers, sunshine, etc.). For example, in this drawing, the child has drawn a sun that is crying, rain, self-representation with one tear, but also a rainbow, which is a representation of joy, and peace (see supplementary material N°2). Isolation was represented in some of the drawings. For example, one child drew himself or herself behind the bars of a prison (see supplementary material N°3). One child was happy to stay at home during the COVID-19 pandemic and then return to school as normal (see supplementary material N°4). One child integrated the war in Ukraine after



the pandemic. He or she also integrated the problem of the large quantity of waste generated by the pandemic, with the overturned dustbins full of masks (see supplementary materials N°5). Many children remembered the protective measures implemented at school during the pandemic. He or she represented the distance measures, the masks, and the separated break time per grade (see additional materials N°6). A child has represented the government meetings (see additional materials N°7).

## Discussion

The COVID-19 pandemic has disrupted daily life around the world, with many consequences for everyone. It is important to monitor the wellbeing of the population after the epidemiological crisis, to document developments, and to take action if necessary. Documenting changes in children's wellbeing is essential, as most mental health problems develop during childhood. The pandemic has had consequences that extend beyond the end of the lockdown, such as the economic crisis, heightened feelings of insecurity and uncertainty about the future. Children's participation rate in this study was low in all schools except one, with a participation rate of 50%, which represented 44% of the total sample. Staff participation was very low in our study, with only 10% of adults accepted to join. Such a low proportion reflected maybe the overpressure of the pandemic period.

## Wellbeing

Before the COVID-19 pandemic, the prevalence of anxiety and depression in children aged 0-9 years were <1% and <0.1% worldwide, 2% and 0.2% in Belgium respectively. In adults (aged over 20 years old), they were 5% each worldwide, 6% and 5% in Belgium respectively [24]. The Institute For Health Metrics And Evaluation has estimated that 15% of the total number of years lived with disability worldwide were due to mental disorders in 2019. In 2020, anxiety and depressive disorders due to the COVID-19 pandemic were 28%, nearly two times higher than in 2019 [25]. In 2020, a study conducted in 204 countries and territories reported a 26% increase in anxiety disorders and a 28% increase in depressive disorders after adjusting for the COVID-19 pandemic. The prevalences also revealed a bigger change in younger age groups, which could indicate the impact of social restrictions and school closures [2].

We investigated anxiety during COVID-19 crisis in a previous study, in the same schools. During the COVID-19 pandemic crisis, 53% had anxiety symptoms, and 31% had a definite state of anxiety [13]. After the COVID-19 pandemic crisis, 63% had anxiety symptoms, and 38% had a state of definite anxiety. A comparison between the two studies for the same participating children suggested that anxiety levels have worsened after the COVID-19 pandemic crisis. These results are in line with literature. In the World Health

Organization report, many people became more anxious with the SARS-CoV-2 virus and, for some, the pandemic amplified serious mental health problems [1]. The long COVID-19 or post-acute sequelae of SARS-CoV-2 may be one of the reasons for the deterioration in wellbeing. Mood changes are typical symptoms described in these post-acute sequelae [26]. A study conducted in UK addressed the effect of SARS-CoV-2 infection on cognitive functions. It showed that infection with the SARS-CoV-2 virus led to cognitive dysfunction depending on the severity of the COVID-19 disease and whether the symptoms were persistent and unresolved [27, 28]. Two-thirds of children had symptoms of social desirability and 55% had a definite state of social desirability. The high social desirability score and the negative correlation between social desirability and anxiety scores suggest that anxiety scores were underestimated. Especially in younger children (6-7 years old) the social desirability scores were the highest. Regarding the comparison of scores for children who participated in both studies, anxiety scores were higher after the pandemic crisis than during. In contrast, social desirability scores were lower after the COVID-19 pandemic crisis. One principal was very interested in an adapted questionnaire for children. She expressed the need to adapt questionnaires according to the age of the child with relevant questions. A specific questionnaire on school premises can help school staff monitor children's wellbeing and refer them to the appropriate people in order to limit the consequences in the future. Wellbeing has deteriorated over time. Even though schools were not closed during the lockdown period in Belgium, the COVID-19 pandemic and its consequences have left their mark on the children. A comparison between anxiety scores and depression scores over time was not possible due to the low staff participation rate in this study. One possible answer to this could be that staff wish to move on and not think about the pandemic. For example, one of the school's principals said that the majority of his staff did not want to take part in the survey because they were so tired of hearing about the pandemic. Which is also a sign of wellbeing and personal development, to want to move on and look to the future.

## Wellbeing in drawings

Expressing themselves orally in the right words is not always easy for children. Children express themselves more easily through drawings, and most of them enjoy drawing. The wellbeing expressed in drawings can be a challenge to interpret, as every child is different. The drawings are in some way a representation of their world, and the investigators need appropriate tools to interpret the drawings. A school is a place of learning in terms of knowledge, but also of interaction with others and personal development. The COVID-19 pandemic has compromised these different aspects with various protective measures, confinement, limitation of outdoor activities, etc. By comparing the three drawings,

the investigators were able to investigate the children's perception of their wellbeing over different temporalities. A specific scale was adapted to be as accurate as possible in terms of interpretation. At the same time, each drawing was carefully analyzed to identify specific indications and interpretations.

The representation of isolation and the absence of green spaces suggest a deterioration in wellbeing. The period of the COVID-19 pandemic crisis was a time of confinement and restricted movement. Studies have shown the benefits for wellbeing and mental health of access to green and blue spaces [29–33]. Only 16% of children did not like drawing and were minimalist in their drawings (almost no use of varied colors, few additional elements apart from the instructions, few elements relating to wellbeing, etc.). This limits misinterpretation as the drawings did not provide contradictory information. Conversely, it may also indicate social desirability and that the children are responding to what is expected of them. Only 3% of children admitted they never drew and 17% admitted to rarely drawing. The representation of positive facial expressions was 17% in their drawings during the pandemic, against 73% before, and 63% after the pandemic. Positive contents were included in 20% of drawings during the pandemic, against 47% before and 49% after. Negative facial expressions were reported in 31% during the pandemic, against 3% before and 6% after. Negative contents were included in 19% of their drawings during the pandemic, against 2% before and 5% after. During the COVID-19 pandemic, the protective mask covered the face, so the children depicted masks on people's faces, illustrating the difficulty of interpreting facial expressions in real life, but also in their drawings with masks. Some children expressed their feelings in tears, rainy days, signs, isolation, etc. Overall, the pandemic was a difficult period, which was reflected in the drawings as isolation, sadness, anger, sickness, etc. These results are similar to those of the study using the three-drawing method, where children drew more positive facial expressions before and after confinement, and where sadness was included during the period [23]. COVID-19 items were represented in 73% of drawings "during the COVID-19 pandemic". More than one item was represented in 28% of drawings. There was confusion in using COVID-19 items before the pandemic period in 2% of the drawings. In the majority of "during the COVID-19 pandemic" drawings, the elements of COVID-19 were represented by the child himself or other people wearing face masks. The physical distance was expressed in some drawings by 1.5 meters, and the coronavirus itself was expressed in rare drawings, by the sign or figure of the coronavirus. In a few drawings, we observed the representation of a hydroalcoholic gel. In almost all the drawings, the children represented other persons. In most of the drawings, the other persons appeared to be their friends

or classmates. In some cases, the children represented their teachers. Parents were practically absent from the drawings. References to school, which were one of the instructions given for the three drawings, were mostly represented in the drawings. Representations of the school were more frequent in the drawings "before the COVID-19 pandemic", at 93% compared with 75% in the drawings "during the COVID-19 pandemic" and 82% in the drawings "after the COVID-19 pandemic". This may suggest that children felt more comfortable and secure with school before the pandemic.

The house was represented in 20% of "during the COVID-19 pandemic". However, almost no children drew their parents. One study suggested that the lack of representation of parents during the confinement was due to the uncertainty and lack of adult control over the situation, which could lead children to represent their home as a place where they felt relatively safe [23]. The representation of wellbeing in the drawings varied. The wellbeing items were represented in 20% of drawings "during the COVID-19 pandemic" compared to 66% in drawings "before the COVID-19 pandemic" and 69% in drawings "after the COVID-19 pandemic". The COVID-19 pandemic was a period of confinement, of staying at home, of sickness, and of being away from people, which is reflected in the lower number of items listed under wellbeing. Some of the drawings depicted solitude, showing them alone in front of the window of their house, lying in bed, behind bars, etc. One child represented his school with its windows barricaded with nailed wooden planks in the drawing "during the COVID-19 pandemic".

One child remembered the precedent study we led in 2021 and represented us in the drawing. Another child represented a bin full of face masks, suggesting the waste problems caused by the pandemic. The same child drew a sign saying "war in Ukraine", suggesting new insecurity. Colors play an important role in the meaning of the drawings [34]. During the different drawing periods, the majority of children used colors, from 79% up to 82%. Monitoring changes in wellbeing over time is important, particularly for children. Most mental health problems in adulthood arise from difficulties encountered in childhood. School is an environment where children need to feel secure to develop their full potential. However, they can encounter difficulties during their school journey, such as learning difficulties, dropping out, and bullying by other children, which can affect their short- and long-term wellbeing. Wellbeing is not a static state and evolves as a function of the family situation, the child's environment, the child's entourage, as well as the child himself, which makes it even more important to monitor wellbeing over time.

## Limitations

Our study had certain limitations. Wellbeing questionnaires

were answered by 13% of children and 10% of staff. Some teachers expressed their feelings towards the direction of the school and explained they were tired of hearing about COVID-19. This can be interpreted as a wellbeing response in that they want to move out. The questionnaire was entirely completed by 98% of the participating children. To calculate the RCMAS scores, all the questions must be answered to calculate scores correctly. Factors other than COVID-19 are involved in the wellbeing evolution, such as the environment, the social environment, the family situation, etc. One school was more represented than the others in this sample. The drawings are subjective and can be difficult to interpret. Care must be taken when interpreting the drawings. The problem of inconsistent wellbeing in some drawings makes interpretation difficult. Some children drew elements linked to sadness (tears, sad faces, clouds, dark colors) and elements linked to happiness (butterflies, flowers, sun, etc.) in the same drawing. Oral explanations of the drawings by the children would have been interesting to add to the interpretations. However, 102 children took part in the drawings and adding this aspect to the organization of the study would have been complicated.

## Conclusion

In conclusion, the COVID-19 pandemic has had a huge impact on children, both in terms of their wellbeing and their perception of the pandemic. Anxiety has increased, urging to limit further consequences later in life.

## Abbreviations

**COVID-19:** Coronavirus disease

**DYNAttracs:** DYNAMIC of TRANSMISSION of Coronavirus in Schools

**HAD:** Hospital Anxiety and Depression scale

**SES:** Socioeconomic status

**RCMAS:** Revised Children's Manifest Anxiety Scale

**SARS-CoV-2:** Severe acute respiratory syndrome coronavirus 2

**SD:** Standard deviation

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## Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Compliance with Ethics Guidelines

### Study registration

The protocol, informed consent forms, and questionnaires were approved by the Hospital-Faculty Ethics Committee Saint-Luc ("Commission d'Ethique hospitalo-facultaire des Cliniques universitaires Saint-Luc") – UCLouvain, approval number: 2022/06DEC/469. It was registered on clinicaltrials.gov on 28/02/2023, identifier number: NCT05747638.

### Conflict of interest

The authors declare that they have no conflict of interest.

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