



COVID-19 Impact on Pediatrics

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Kids COVID Experience: Beyond the Disease, Understanding Children's Well- being during the COVID-19 Pandemic



Source: Own image

Objectives

- Describe the well-being of children and adolescents during the COVID-19 pandemic
- Discuss socio-ecological factors related to the well-being of children and adolescents during the COVID-19 pandemic
- Review children's perceptions early during the COVID-19 pandemic
- Discuss changes in well-being overtime in children and adolescents during the COVID-19 pandemic

Pandemic Effects

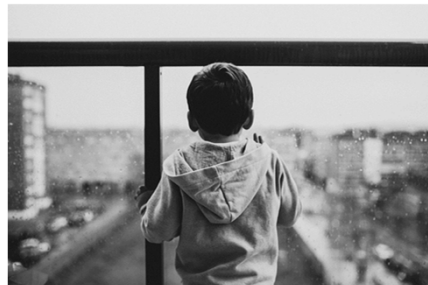
- Physically ill
- Emotional
- Social
- Mental well-being



Source: Pexels

Pandemic by the Numbers*

Cumulative # of child cases	Cumulative % of all cases	Cumulative % hospitalizations	Cumulative % Deaths
15,578,985	18%	0.08%	0.00%-0.27%



Source: Pexels

*as of 4/27/2023. The American Academy of Pediatrics. Children and COVID-19: State-Level Data Report (aap.org). Accessed 5/2/2023

Impact on Children

“At this time, it still appears that severe illness due to COVID-19 is rare among children. However, there is an urgent need to collect more data on longer-term impacts of the pandemic on children, including ways the virus may harm the long-term physical health of infected children, as well as its emotional and mental health effects.”

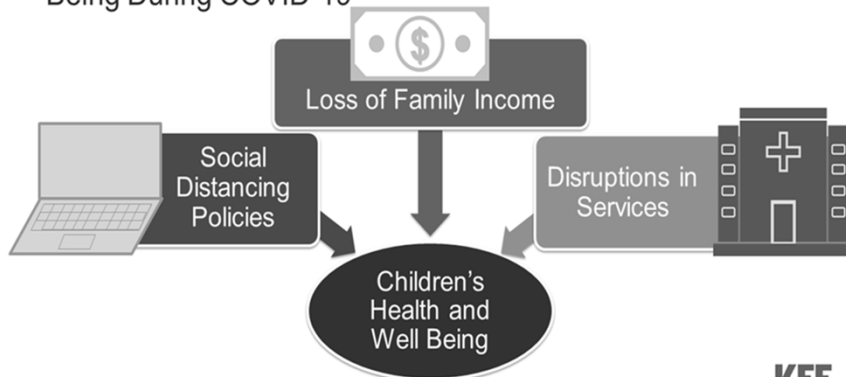
- AAP, **Children and COVID-19: State-Level Data Report**
May 2021

Factors Influencing Effects

- **Child Factors**
 - Social isolation
 - Family stress
 - Routine changes
 - Virus related anxiety
 - School closures/remote learning
- **Family Factors**
 - Job/Income Loss
 - Financial Instability
 - Child care
 - Loss of family member d/t virus

Figure 1

Factors Negatively Impacting Children's Health and Well-Being During COVID-19



SOURCE: Rachel Garfield and Priya Chidambaram, Children's Health and Well Being During the Coronavirus Pandemic (KFF, September 2020)

KFF



Source: Pexels

Background

- Canadian and Chinese children reported decreased rates of physical activity during COVID-19 pandemic
- Chinese children during the COVID-19 pandemic
 - increased distraction
 - increased irritability
 - more fear



Source: Pexels

Background

- > 25% worse mental health
- 14% worse behavioral health
- Single parents and parents of young children most affected
- Overall, quality of life and psychosocial functioning of children in the U.S. early in the pandemic was less known



Source: Pexels

Patrick et al. 2020.
Pediatrics, 146(4).











Study Aims

- **Aim 1:** To characterize the well-being of children and adolescents during the COVID-19 pandemic
- **Aim 2:** To examine socio-ecological factors related to the well-being of children and adolescents during the COVID-19 pandemic
- **Aim 3:** To qualitatively explore children's perceptions of the COVID-19 pandemic through open-ended, written responses

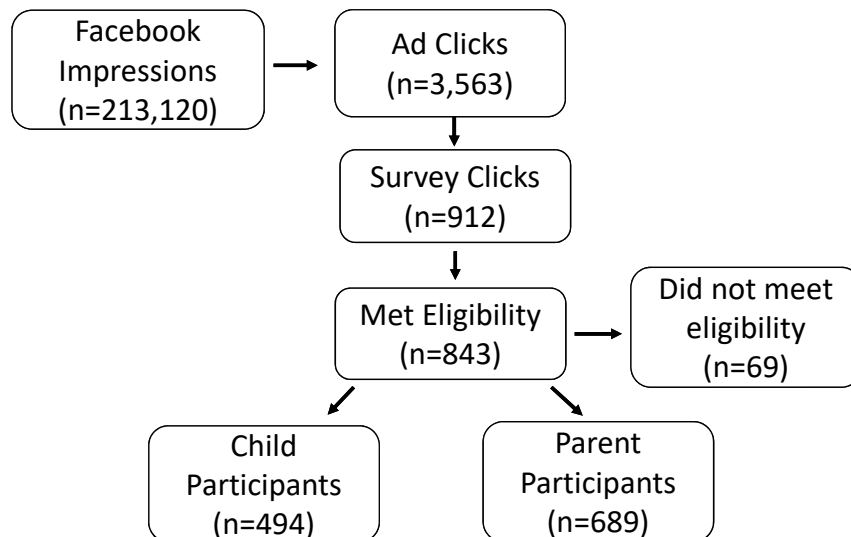


Source: Pexels

Measures

Measure	Time 1	Time 2
COVID Exposure and Family Impact Scale (CEFIS)		
PEDSQL		
PROMIS Family Relationship		
NIH Toolbox Loneliness Scale		
Qualitative Interview (optional)		
CD-RISC10		

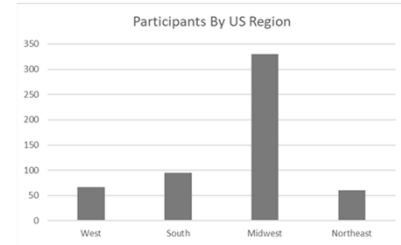
Overall Study Enrollment



Demographics _Time 1

Table 1. Parent/child dyad demographic characteristics (N=461)

	Mean (SD) or n (%)
Child Age in years (SD)	11.85 (2.72)
Gender (<i>child</i>)	
Male	236 (51.4%)
Female	225 (48.6%)
Race (<i>child</i>)	
White	416 (90.2%)
Non- White	45 (9.8%)
Ethnicity	
Hispanic	43 (9.4%)
Non- Hispanic	415 (90.6%)
Income	
Under \$25,000	31 (6.8%)
\$25,001- \$50,000	57 (12.6%)
\$25,001- \$75,000	54 (11.9%)
\$75,001- \$100,000	80 (18.7%)
\$100,001- \$150,000	137 (30.2%)
More than \$150,000	85 (18.7%)
Other	4 (0.9%)
Current Employment Status	
Working full-time (>30 hrs/week)	264 (57.6%)
Working part-time (<30 hrs/week)	76 (16.6%)
Unemployed	118 (25.8%)



Source: Pexels

Skeens, M. A., Hill, K., Olsavsky, A., Ralph, J., Udaipuria, S., Akard, T. F., & Gerhardt, C. A. (2023). Family Functioning Buffers the Effects of the COVID-19 Pandemic on Children's Quality of Life and Loneliness. *Frontiers in Psychology, 13*, 8669.

COVID Exposure _T1

COVID Questionnaire Part- 1 (COVID Exposure):

	No	Yes
We had a "stay at home" order	15 (3.27%)	444 (96.73%)
Our schools / child care centers were closed	1 (0.22%)	458 (99.78%)
Our child/ren's education was disrupted	23 (5.01%)	436 (94.99%)
We were unable to visit or care for a family member	99 (21.57%)	360 (78.43%)
Our family lived separately for health, safety or job demands	405 (88.24%)	54 (11.76%)
Someone moved into (or back into) our home	425 (92.59%)	34 (7.41%)
We had to move out of our home	455 (99.13%)	4 (0.87%)
Someone in the family kept working outside the home (essential personnel)	158 (34.42%)	301 (65.58%)
Someone in the family is a healthcare provider/first responder providing direct care	332 (72.49%)	126 (27.51%)
We had difficulty getting food	392 (85.40%)	67 (14.60%)
We had difficulty getting medicine	430 (93.68%)	29 (6.32%)
We had difficulty getting health care when we needed it	392 (85.59%)	66 (14.41%)
We had difficulty getting other essentials	338 (73.64%)	121 (26.36%)
We self-quarantined due to travel or possible exposure	372 (81.05%)	87 (18.95%)
Our family income decreased	277 (60.48%)	181 (39.52%)
A member of the family had to cut back hours at work	262 (57.33%)	195 (42.67%)
A member of the family was required to stop working (expect to be called back)	332 (72.33%)	127 (27.67%)
A member of the family lost their job permanently	437 (95.83%)	19 (4.17%)
We lost health insurance/benefits	446 (97.38%)	12 (2.62%)

COVID Exposure _T1

COVID Questionnaire Part- 1 (COVID Exposure) (cont'd)

	No	Yes
We missed an important family event or it was canceled (e.g., wedding, graduation, birth, funeral, travel [including vacation], other)	60 (13.07%)	399 (86.93%)
Someone in the family was exposed to someone with COVID-19	384 (83.84%)	74 (16.16%)
Someone in the family had symptoms or was diagnosed with COVID-19	403 (87.99%)	55 (12.01%)
Someone in the family was hospitalized for COVID-19	446 (97.59%)	11 (2.41%)
Someone in the family was in the Intensive Care Unit (ICU) for COVID-19	450 (98.68%)	6 (1.32%)
Someone in the family died from COVID-19	453 (98.91%)	5 (1.09%)



Source: Pexels

COVID-19 Exposure Score **Mean (SD)**
8.00 (2.54)

COVID Impact-Parent _T1

COVID Questionnaire Part- 2 (COVID Impact):

	Made it a lot better	Made it a little better	No Change	Made it a little worse	Made it a lot worse
Parenting	24 (5.26%)	88 (19.30%)	133 (29.17%)	175 (38.38%)	36 (7.89%)
How family members get along with each other	28 (6.11%)	116 (25.33%)	140 (30.57%)	144 (31.44%)	30 (6.55%)
Ability to care for your child	44 (9.73%)	87 (19.25%)	213 (47.12%)	87 (19.25%)	21 (4.65%)
Ability to care for other children in your family	23 (6.07%)	64 (16.89%)	187 (49.34%)	77 (20.32%)	28 (7.39%)
Ability to care for older adults or people with disabilities in your family	10 (3.12%)	7 (2.18%)	112 (34.58%)	90 (28.04%)	103 (32.09%)
Your physical wellbeing – exercise	30 (6.59%)	75 (16.48%)	86 (18.90%)	138 (30.33%)	126 (27.69%)
Your physical wellbeing - eating	21 (4.58%)	72 (15.69%)	101 (22.00%)	160 (34.86%)	105 (22.88%)
Your physical wellbeing – sleeping	26 (5.71%)	51 (11.21%)	96 (21.10%)	160 (35.16%)	122 (26.81%)
Your emotional wellbeing – anxiety	9 (1.98%)	14 (3.08%)	72 (15.86%)	173 (38.11%)	186 (40.97%)
Your emotional wellbeing – mood	13 (2.86%)	28 (6.17%)	67 (14.76%)	217 (47.80%)	129 (28.41%)

Mean (SD)
Overall, how much distress have you experienced related to COVID-19? 6.20 (2.07)

COVID-19 Impact Score 45.20 (9.44)

In general, across all your children, how much distress have your children experienced related to COVID-19? 5.97 (2.21)

COVID Impact- Child_T1

COVID Questionnaire Part- 2 (COVID Impact) - CHILD

	Made it a lot better	Made it a little better	No Change	Made it a little worse	Made it a lot worse
How family members get along with each other	27 (6.2%)	105 (24%)	141 (32.3%)	131 (30%)	32 (7.3%)
How I got along with my brother or sister	22 (5%)	84 (19.1%)	108 (24.5%)	117 (26.6%)	42 (9.5%)
Your physical wellbeing - eating	30 (6.8%)	89 (20.3%)	208 (47.5%)	87 (19.9%)	22 (5%)
Your physical wellbeing – sleeping	38 (8.6%)	60 (13.6%)	149 (56.1%)	132 (30%)	57 (13%)
Your emotional wellbeing – worry	13 (3%)	30 (9.8%)	137 (31.1%)	181 (41.1%)	74 (16.8%)
Your emotional wellbeing – mood	15 (3.4%)	44 (10.1%)	130 (29.7%)	185 (42.3%)	59 (13.5%)
	<u>Mean (SD)</u>				
Overall, how much distress have you experienced related to COVID-19?	5.05 (2.45)				
In general, how much distress have your parents experienced related to COVID-19?	6.17 (2.48)				

Child QoL & Loneliness_T1

Table 2. Comparison of parent and child reports of child quality of life to norms

	Normative Sample M (SD)	Current Sample M (SD)	df	t-value	Pr > t	(95% CI)
PEDSOL Child Report						
Total Functioning	82.87 (13.16)	75.35 (15.12)	6431	11.69	<.0001	6.26-8.44
Physical Functioning	86.86 (13.88)	80.67 (18.47)	6421	8.98	<.0001	4.84-7.10
Emotional Functioning	78.21 (18.64)	63.41 (21.18)	6420	16.26	<.0001	13.01-19.51
Social Functioning	84.04 (17.43)	82.20 (17.77)	6407	2.18	0.03	0.18-3.90
School Functioning	79.92 (16.93)	71.91 (18.57)	6367	9.71	<.0001	6.39-9.03
PEDSOL Parent Report						
Total Functioning	81.34 (15.92)	74.12 (16.16)	10319	7.09	<.0001	5.22-9.06
Physical Functioning	83.26 (19.98)	78.00 (20.15)	10300	4.13	<.0001	2.76-7.50
Emotional Functioning	80.28 (16.99)	59.83 (21.45)	10294	18.74	<.0001	18.31-22.17
Social Functioning	82.15 (20.08)	82.72 (17.49)	10285	0.45	0.66	-3.08-1.18
School Functioning	76.91 (20.16)	73.95 (20.79)	8713	16.89	<.0001	18.25-21.43
Loneliness Score	50.00 (10.00)	56.12 (11.27)	460	11.66	<.0001	5.09-7.15

Skeens, M. A., Hill, K., Olsavsky, A., Ralph, J., Udaipuria, S., Akard, T. F., & Gerhardt, C. A. (2023). Family Functioning Buffers the Effects of the COVID-19 Pandemic on Children's Quality of Life and Loneliness. *Frontiers in Psychology*, 13, 8669.

Potential Covariates_T1

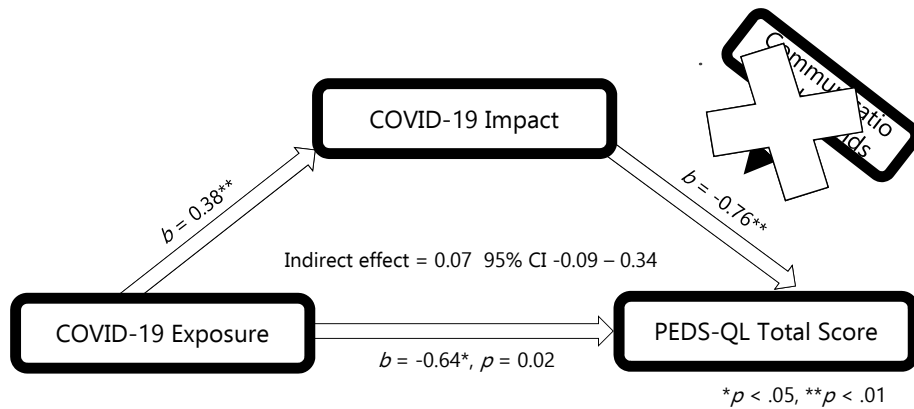
Table 3. Correlations between demographic characteristics and child report of QOL and loneliness

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. PEDSQL Total Functioning									
2. Loneliness	-.60**								
3. Family Relationships	.36**	-.49**							
4. Communication with Friends	.19**	-.13**	-.01						
5. Child Age	-.07	.16**	-.15**	.21**					
6. Child Sex	.03	.11*	-.03	.15**	-.01				
7. Child Ethnicity	.13**	.03	-.01	.08	-.02	-.06			
8. Prior Income	.21**	-.01	-.12*	.13**	.03	-.06	.17**		
9. COVID Exposure	-.20**	.06	-.05	-.09*	-.06	.02	-.16**	-.26**	
10. COVID Impact	-.30**	.25**	-.18**	-.09	-.06	-.05	.11*	-.06	.14**

*p < .05; **p < .01

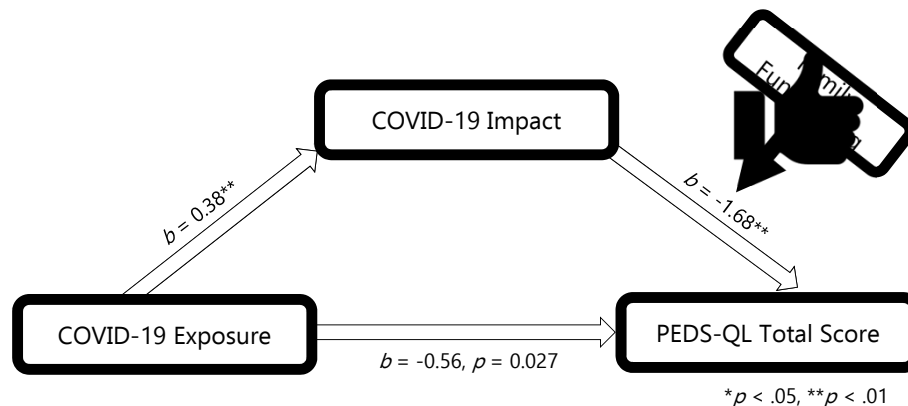
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Do Friends Help?



R² = 0.18; controlling for age, sex, ethnicity and prior family income of which income and ethnicity were significantly associated with PEDS-QL total score.

Does Family Help?



$R^2 = 0.26$; index of moderated mediation = 0.01, 95% CI [0.001, 0.02];
 controlling for age, sex, ethnicity and prior family of which income and
 ethnicity was significantly associated with PEDS-QL total score.

Qualitative Sample

- Recruitment
 - 340 agreed to interview
 - 140 contacted
 - 55 interviewed
- Children
 - Equal distribution of sex
 - Mean age 11.97 (SD = 2.81)



Source: Pixabay

6-Month Follow-Up_T2

- ~ 200 families completed 6-month follow-up
- Attrition analysis
 - No differences in demographics, but non-participating parents had lower family functioning and higher loneliness scores

T2 Parent/child dyad characteristics (n=195)

	Mean (SD)	N (%)
Age in years (SD)	12.50 (2.66)	
Gender		
Male	107 (54.87%)	
Female	88 (45.13%)	
Race		
White	172 (88.66%)	
Non- White	22 (11.34%)	
Ethnicity		
Hispanic	11 (5.67%)	
Non- Hispanic	183 (94.33%)	
Income		
Under \$25,000	9 (4.69%)	
\$25,001- \$50,000	17 (8.85%)	
\$25,001- \$75,000	28 (14.58%)	
\$75,001- \$100,000	35 (18.23%)	
\$100,001- \$150,000	49 (25.52%)	
More than \$150,000	52 (27.08%)	
Other	2 (1.04%)	
Current Employment Status		
Working full-time (>30 hrs/week)	132 (67.69%)	
Working part-time (<30 hrs/week)	24 (12.31%)	
Unemployed	39 (20.00%)	

COVID Exposure/Impact_T2

- Fewer children with restrictions, but 52% had family member exposed, 29% sxs or infected, 8% hospitalized, 3% death

Measure	T1_Score	T2_Score
COVID Exposure	8 (2.54)	7.65 (3.21)
COVID Impact_Parent	45.20 (9.44)	48.03 (8.04)
COVID Distress_Parent	6.20 (2.07)	6.64 (1.93)
COVID Distress_Child	5.05 (2.45)	5.48 (2.34)

QoL & Loneliness_T2

- Total QoL & loneliness unchanged
- Associated with COVID exposure, impact, family functioning
- No change over time except school function
- Older children and lower income had greater decline in Total QoL
 - physical & school in older children

Source: Pixabay



Resilience_T2

- CD-RISC 10
 - Parent reported scores 36.2 (6.54)
 - Child reported scores 34.19 (7.57)
- Between 50th and 75th percentile



Source: Pixabay

Summary

- Results suggest early negative effects of the pandemic on children's QoL and loneliness
- These remain relatively stable over 6 months
- Opportunities to identify families at risk
 - Lower income, older age, and worse family r/s
- Research is needed with more diverse families



Source: Pexels

COVID & Social Determinants of Health

- Inequity & Disparity related to;
 - Income
 - Immigrant background
 - Language barrier
 - Parental education level
 - Access to health care



Image by Freepik

Racial Differences, COVID and Well-Being



Source: Pixabay

Parolin, Z. (2021). What the COVID-19 pandemic reveals about racial differences in child welfare and child well-being: An Introduction to the Special Issue. *Race and social problems*, 13(1), 1-5.

Racial Differences, COVID and Well-Being



Source: loc.gov



COVID and Quality of Life

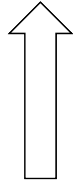
- QOL was worse than normative samples but did not change significantly over time.
- Global data is mixed
 - Some reflect decreased QOL from pre-pandemic samples
 - Some no change
 - Spain & Germany had improved scores



Source: Pixabay

COVID and Mental Health Outcomes

Children and adolescents experience;



Depression

Anxiety

Fear

Concern for pandemic impact on life



Source: Pixabay

Youth and the Pandemic

According to a November 2020 article in the Washington Post:

“Since the coronavirus arrived, depression and anxiety in America have become rampant. Federal surveys show that 40 percent of Americans are now grappling with at least one mental health or drug-related problem. But young adults (ages 18 – 24) have been hit harder than any other age group, with 75 percent struggling.”

Factors and Worse Mental Health Outcomes

- Older adolescent age
- Female
- Rural areas
- Low socioeconomic status
- Family health care worker
- Chronic physical conditions



Source: Pixabay



Source: Pixabay

Elharake, et al (2022). *Child Psychiatry & Human Development*, 1-13.
Sanji, H et al (2021). *Child and adolescent mental health*

Factors and Better Mental Health Outcomes

- Physical exercise
- Positive family relationships
- Social support
- Access to entertainment



Source: Pixabay

Sanji, H et al (2021). *Child and adolescent mental health*

Interventions

- Sparse interventions to prevent and manage mental health outcomes
- Mix of parents/child specific interventions (4 – child only)
- Digital interventions to reduce emotional symptoms or improve emotional well-being
- Two remote recess and exercise interventions

Boldt et al. (2021). International journal of environmental research and public health, 18(5), 2361.

Limitations

- Cross-sectional – lack of longitudinal data
- Lack of validated measures
- Research including minorities and underserved populations is missing



Source: Unsplash

Clinical Implications

- Address pandemic related effects during routine visits
- Begin to address cumulative effects on school performance and outcomes
- Increase mental health services
- Close attention and future intervention development for those with known factors contributing to worse outcomes

Thank you

- Cynthia Gerhardt PhD
- Terrah Foster-Akard PhD
FAAN
- Kathy Vannatta PhD
- Anna Olsavsky PhD
- Kylie Hill BS
- Skeens Lab
- Marketing team
- Children and Families
- Funding acknowledgement:
Nationwide Children's
Intramural Grant



Source: NCH

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Pediatric Long-COVID: What are pulmonologists seeing?

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Disclosures

- None

Objectives

1

Know the definition of “long COVID” in the pediatric population

2

Review pulmonary post COVID clinic – population we are serving, testing


3

Discuss what we have found so far regarding persistent symptoms and lung function changes

Where are we at with COVID?

- Declared no longer a public health emergency by the WHO
- “The emergency phase is over, but Covid is not.”
 - Dr. Maria Van Kerkhove, WHO technical lead on COVID
- No longer the same level of danger
- Learning more and more about long term symptoms even with mild infections
- Some similarities to other respiratory viruses, but also many differences

<https://www.nytimes.com/2023/05/05/health/covid-who-emergency-end.html>



COVID19 in Pediatrics: General Infection

- Overall for most children is usually mild
 - Symptoms similar to other respiratory viral infections, though this has fluctuated with the different variants
 - Mild symptoms include fever, cough, rhinorrhea, sore throat, dyspnea
 - Dyspnea and respiratory distress more common in infants <12 months
 - GI complaints (nausea, vomiting, diarrhea) more common in older children and teens
 - Anosmia and Ageusia seen with early strains, less so with recent omicron wave
 - Recovery within 1-2 weeks

COVID19 in Pediatrics: MIS-C

- Multi-system inflammatory syndrome in children (MIS-C)
 - First described in the UK in case report of 2 children with Kawasaki like symptoms in Pediatrics, August 2020 - 12 year old and 7 year old
 - UK reported similar as early as April 2020
- Occurs in <1% of confirmed COVID cases
- Initially described in the US in 2 patients (aged 9 and 12) as what seemed to be late phase reaction to SARS COV2, no real pulmonary symptoms, but elevated inflammatory markers, diarrhea and abdominal pain

COVID19 in Pediatrics: MIS-C

Now known to generally occur in older children and adolescents

Occurs 2-4 weeks after COVID infection

Usually previously healthy children

Treatment standard, require inpatient treatment

- IVIG recommended
- +/- glucocorticoids depending on severity
 - Can use glucocorticoids alone if no access to IVIG
- ICU support as needed with fluid resuscitation, pressors or inotropes

Post Acute Sequelae of COVID19 or PASC: What we know in adults

“Long haulers” or long-covid

Similar symptoms were reported for SARS outbreak of 2003 and MERS outbreak of 2012

Persistence of symptoms at least 4 weeks after initial infection

- 2 categories
 - Persistent subacute COVID (still having symptoms more like acute infection) in the 4-12 week timeframe
 - Post COVID syndrome, often persisting beyond 12 weeks after initial infection

COVID19 in Pediatrics: PASC

- World Health Organization (WHO) definition
 - At least 2 months of persistent symptoms 3 months after initial diagnosis
 - Not explained by any other diagnosis
- AAP similar but must have physical symptoms that impact daily function
 - May relapse and fluctuate over time.

COVID19 in Pediatrics: PASC

- Most common symptoms reported
 - Headache
 - Fatigue
 - Myalgias
 - Chest Pain
 - Dyspnea
 - Concentration impairment (brain fog)
- Several studies comment on whether some of these could be related to effects from lockdown – isolation, depression, etc

PASC: What we know in adults

- As many as 30% of hospitalized adults report persistent symptoms
 - Dyspnea being the most common (22%) as well as continued cough
 - Fatigue common as well
- Pulmonary specific – decreased diffusion capacity with restrictive physiology
 - Ground glass opacities
 - Potential fibrotic changes
 - Limited literature on bronchospasm or bronchodilator response (although decreased FEV1 is reported)

Development of Post-COVID Clinic

- Questions regarding this population
 - Common respiratory symptoms?
 - Do they have changes in lung function? In lung imaging?
 - How long after infection do these symptoms seem to persist?
 - Does it matter if patients are vaccinated or not with regards to PASC?
 - Does prior history of pulmonary disease (mostly asthma) increase likelihood of persistent pulmonary symptoms?
 - Are there other risk factors that make PASC more likely?

COVID19 in Pediatrics: PASC

- Dutch study from August 2021 (retrospective, observational)
 - 89 children
 - Dyspnea reported by over half of those surveyed
- Radiology study out of Germany published 2023 looked at MRIs and ventilation perfusion scans
 - Healthy controls had best V/Q match
 - Lowest V/Q match in patients with shorter time period to study participation from Covid infection
 - More likely if <180 days since COVID infection

Other pediatric literature

Small cohort (N=29) out of Philadelphia (CHOP) – described long term reported symptoms post COVID – dyspnea, cough, exercise intolerance

- Had 6 minute walk data on 9 patients, did see significant heart rate elevation and no change in oxygenation, no follow up data
- Demonstrated 28% of their cohort with bronchodilator response on spirometry

Prospective study out of Russia published in European Respiratory Journal

- Looked at long term symptoms for children after hospitalization
- Found that risk factors for persistent symptoms were older age (12-18) and history of allergic/atopic diseases

Development of Post-COVID Clinic

Objective: Comprehensively evaluate post-acute COVID-19 syndrome (PASC) pulmonary symptoms in adolescents (Long-COVID pulmonary symptoms).

Candidates: Pediatric patients >8 years with PASC pulmonary symptoms for at least 1 month after initial infection date. Athletes and non-athletes welcomed.

- **Over 8 years old because of need to participate in fairly extensive lung function testing**

Symptoms: Typical PASC pulmonary symptoms include shortness of breath (resting or with activity), cough, wheezing, chest/throat pain, and decreased exercise capacity.

Development of Post-COVID Clinic

- **Evaluation:** Testing includes
 - Six-minute walk
 - Chest xray (if not obtained within the last month)
 - Spirometry (both pre and post bronchodilator)
 - Plethysmography (lung volume measurements)
 - DLCO testing (diffusing capacity)
 - Other imaging or testing determined by evaluating physician (think exercise testing, chest CT, etc)



So, what have we seen?

- Aimed to describe long term subjective and objective pulmonary abnormalities
- Initially observed 82 adolescents, mostly previously healthy and largely NOT requiring hospitalization
- Saw 3.5 months after infection (on average)
 - Although some patients referred in that subacute time frame of 4-6 weeks after initial infection

Initial Cohort

	Initial visit (n=71)	Follow-up (n=31)
Female sex	57.8%	64.5%
Caucasian	81.7%	81.3%
BMI	23.8 ± 6.7	22.9 ± 5.7
Age at diagnosis (y)	15.5 ± 2.2	15.4 ± 2.6
Time to pulm eval (mo)	4.3 ± 3.1	7.0 ± 3.1
Co-morbidities		
Obesity	19.7%	22.6%
HTN	4.3%	0%
Asthma	28.6%	28.1%
Mild intermittent	21.4%	25.0%
Mild persistent	5.7%	0
Moderate persistent	1.4%	3.1%
Anxiety	26.1%	23.3%
COVID vaccinated	24.3%	19.4%
Vaping exposure	11.3%	12.9%
Tobacco exposure	14.1%	6.4%
Private Insurance	76.1%	87.5%
Hospitalized for COVID	7.0%	6.5%
Competitive athlete	80.3%	77.4%

Symptoms commonly reported at presentation



Cough (30%)



Chest pain (61%)



Dyspnea at rest (51%)



Exertional dyspnea (90%)



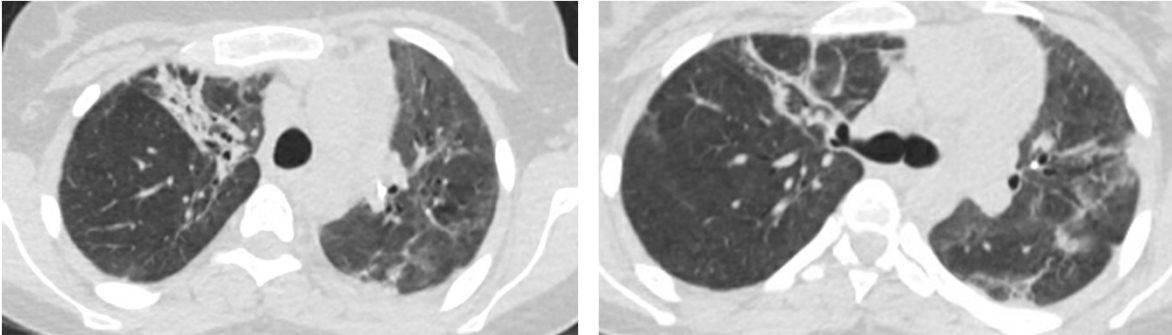
Around 80% presented with 2 or more symptoms

Any imaging abnormalities?



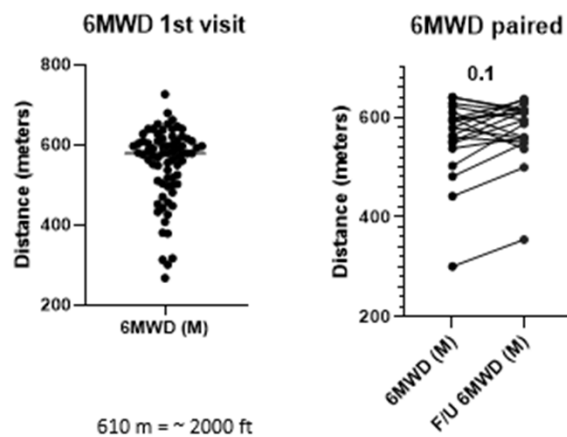
- Vast majority normal
- 8% abnormal – hyperinflation usually
- 16% had chest CT scans, generally normal

Fibrosis and Bronchiectasis in an 18 yo female after COVID related ARDS



- IMPRESSION: 1. Evolution of fibrosis throughout the lungs with decreased volumes and progressive bronchiectasis bilaterally, as detailed above. Fibrotic changes are more discrete and consolidated compared to prior study.

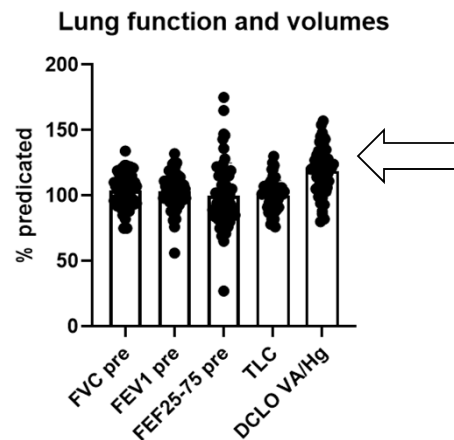
Functional limitations – evaluation with 6MWT



Lung function testing

Measure (% predicted)	Pre-bronchodilator	Post-bronchodilator	% Change
FVC	103.4 ± 13.1	104.2 ± 13.5	0.38 ± 3.6
FEV1	102.4 ± 13.3	107.0 ± 13.9	4.1 ± 6.7
FEF 25-75	99.4 ± 24.7	113.5 ± 23.4	16.2 ± 20.4
TLC	98.4 ± 12.7		
RV/TLC	20.4 ± 10.0		
Diffusing capacity	118.0 ± 17.1		
Normal spirometry	83%		
Bronchodilator positivity	31%		

Lung function testing



Diagnostic Phenotypes

Bronchodilator responsiveness
(an “asthma” phenotype)

Paradoxical Vocal Fold Motion
Disorder (previously VCD)

Persistent functional limitations

- Fatigue, persistent dyspnea with normal lung function testing, no diagnosis of VCD

Bronchodilator responsiveness

- What are we doing for these patients?
- 43% of these patients were prescribed and ICS or ICS/LABA combo
 - 10% just ICS and 33% ICS/LABA combo
- At follow up
 - 85% reported clinical response
 - Due to mostly normal lung function testing initially, most patients did not have repeat spirometry and response documented based on clinic symptoms

Paradoxical Vocal Fold Motion Disorder

- VCD
- Treated in conjunction with ENT and speech therapy
- This was 13% of the 82 individuals initially seen in the clinic
- One patient diagnosed with a laryngeal sensory neuropathy
 - Treated with a superior laryngeal nerve block

[https://www.annallergy.org/article/S1081-1206\(16\)30522-1/fulltext](https://www.annallergy.org/article/S1081-1206(16)30522-1/fulltext)

Persistent functional limitations

- Almost all patients presenting with fatigue and dyspnea
- About half had no abnormalities on imaging, on lung function testing or exam
- Deconditioning?
- Pulmonary rehab (13% of our initial cohort)
 - Improves endurance and strength
 - Mental health support



What factors help predict outcomes?

- Multivariable models adjusting for age, sex, race, and insurance status
- **Obesity, anxiety, cough and dyspnea** were associated with **decreased 6MWT** distance
- **Female sex and initial dyspnea** were associated with **higher Borg Dyspnea and Fatigue** scores
- There were no significant factors associated with heart rate alterations during 6MWT or bronchodilator responses during spirometry.

What factors help predict outcomes?

- Other studies have seen risk factors for overall long COVID include
 - Older age (adolescents vs young children)
 - Female gender
 - Poor mental or physical health prior to COVID infection

Role of mental health

- Since initial collection of data we have also brought in help of our mental health coordinators
- Doing screening each visit for anxiety and depression
- So far we do have many patients with h/o mental health diagnoses
 - Many who already are on medication or have providers
- Recent article American Psychological Association
 - Reality of Pediatric Long Covid

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