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."

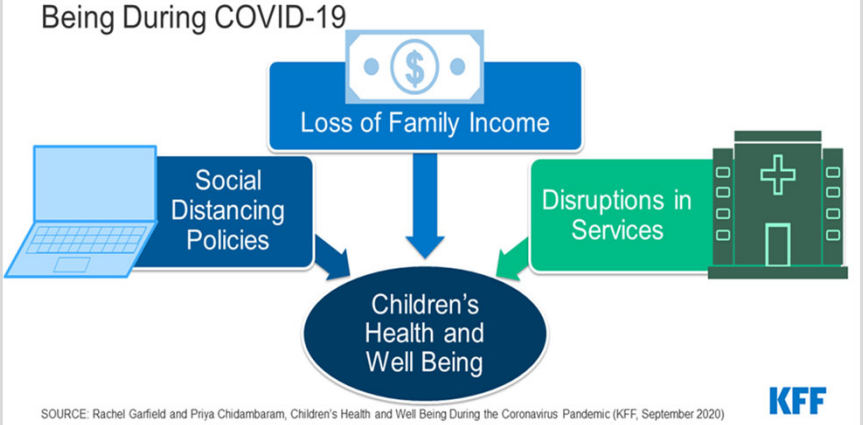
- AAP, **Children and COVID-19: State-Level Data Report May 2021**

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

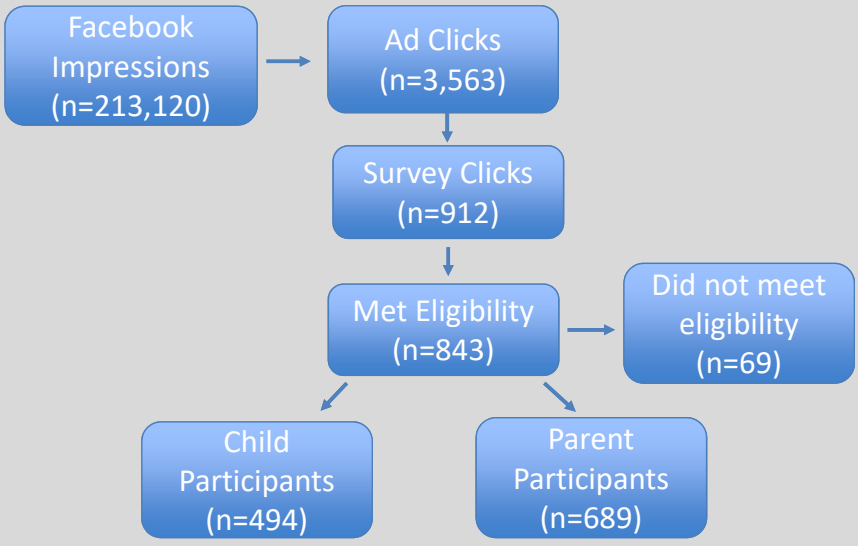
- <u>Aim 1:</u> To characterize the well-being of children and adolescents during the COVID-19 pandemic
- <u>Aim 2:</u> To examine socio-ecological factors related to the well-being of children and adolescents during the COVID-19 pandemic
- <u>Aim 3:</u> To qualitatively explore children's perceptions 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		

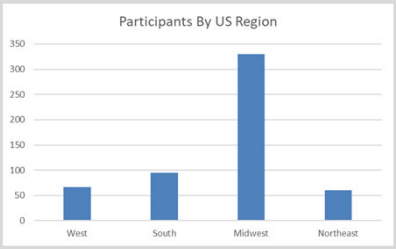
Overall Study Enrollment



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 *(child)*	
Male	236 (51.4%)
Female	223 (48.6%)
Race *(child)*	
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	86 (18.9%)
$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

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

COVID-19 Impact Score	45.20 (9.44)

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%)

	Mean (SD)
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% C
PEDSQL Child Report						
Total Functioning	82.87 (13.16)	75.35 (15.12)	6431	11.69	**<.0001**	6.26-8.
Physical Functioning	86.86 (13.88)	80.67 (18.47)	6421	8.98	**<.0001**	4.84-7.
Emotional Functioning	78.21 (18.64)	63.41 (21.18)	6420	16.26	**<.0001**	13.01-1(
Social Functioning	84.04 (17.43)	82.20 (17.77)	6407	2.18	**0.03**	0.18-3.
School Functioning	79.92 (16.93)	71.91 (18.57)	6367	9.71	**<.0001**	6.39-9.
PEDSQL Parent Report						
Total Functioning	81.34 (15.92)	74.12 (16.16)	10319	7.09	**<.0001**	5.22-9.
Physical Functioning	83.26 (19.98)	78.00 (20.15)	10300	4.13	**<.0001**	2.76-7.
Emotional Functioning	80.28 (16.99)	59.83 (21.45)	10294	18.74	**<.0001**	18.31-2
Social Functioning	82.13 (20.08)	82.72 (17.49)	10283	0.45	0.66	-3.08-1
School Functioning	76.91 (20.16)	73.93 (20.79)	8715	16.09	**<.0001**	18.25-2
Loneliness Score	50.00 (10.00)	56.12 (11.27)	460	11.66	**<.0001**	5.09-7.

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

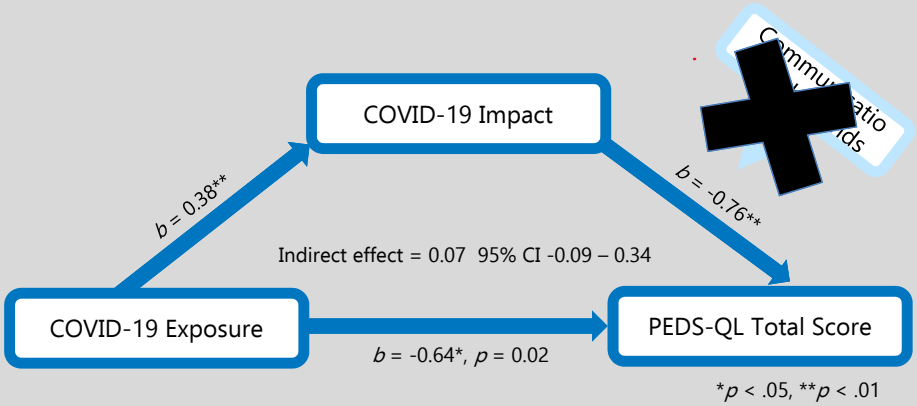
Table 3. Correlations between demographic characteristics and child report of QOL and loneliness

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****

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

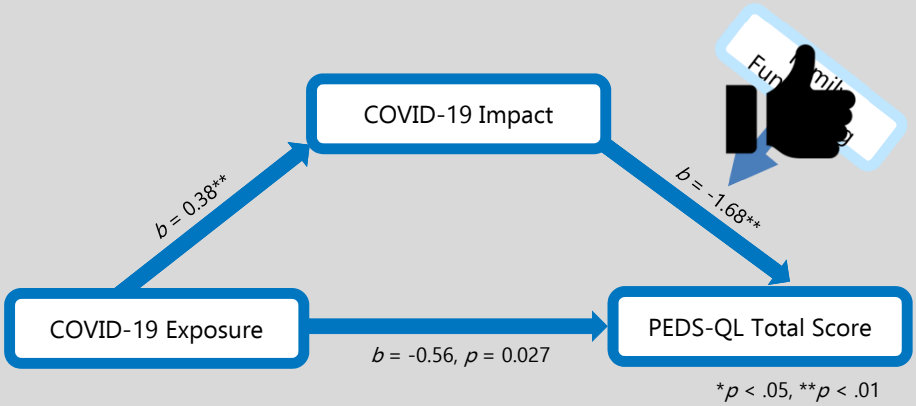
Skeens, M. A., Hill, K., Olsavsky, A., Ralph, J., Udaipuria, S., Akard, T. F., & Gerhardt, C. A. (2023). Family Functioning Buffers the Effects of the COVID-19 Pandemic on Children's Quality of Life and Loneliness. *Frontiers in Psychology*, *13*, 8669.

Do Friends Help?



$R^2 = 0.18$; 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

Qualitative Interviews

Source: Pexels

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) or 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

Source: Pixabay

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.
Samji, 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

Samji, 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

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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%

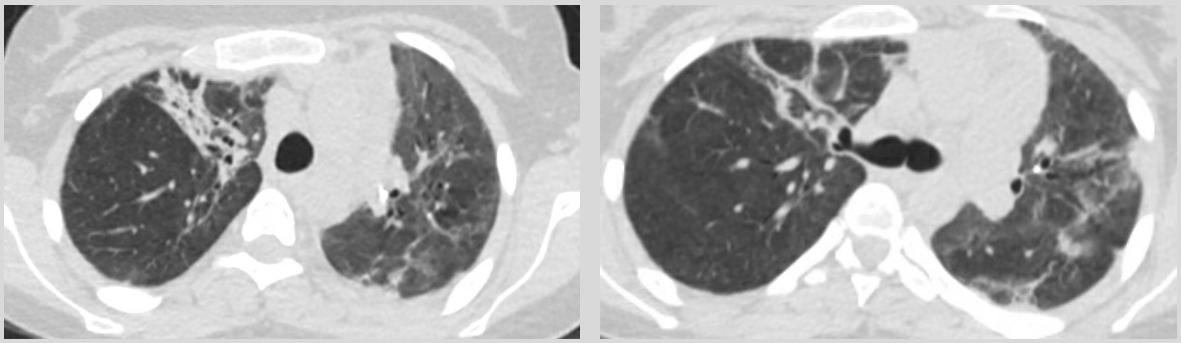
Symptoms commonly reported at presentation

- Cough (30%)
- Chest pain (61%)
- Dyspnea at rest (51%)
- Exertional dyspnea (90%)
- Around 80% presented with 2 or more symptoms

Any imaging abnormalities?

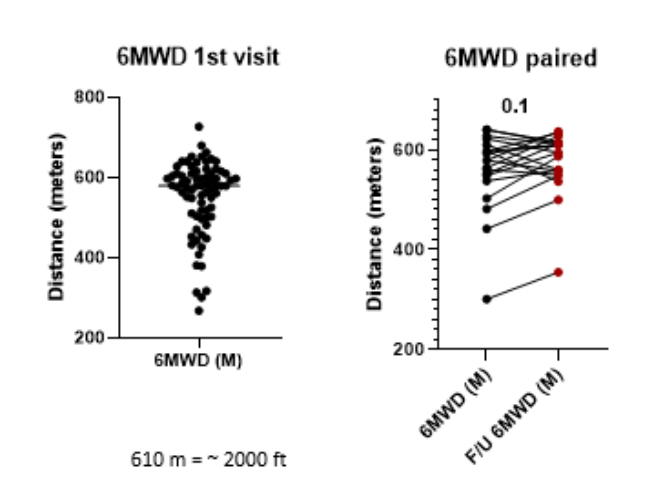
- Vast majority normal
- 8% abnormal – hyperinflation usually
- 16% had chest CT scans, generally normal

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.

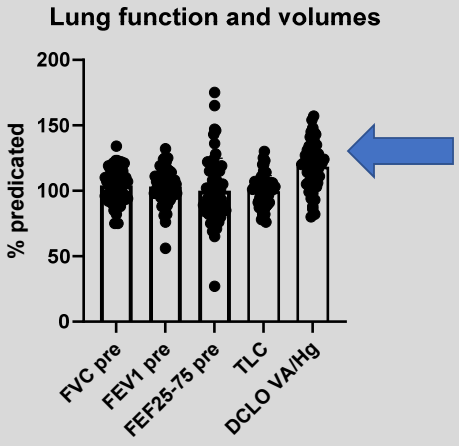
Functional limitations – evaluation with 6MWT



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

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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