Phenotyping Long COVID in Children in Primary Care: A Case-Based Study Using the Human Phenotype Ontology.

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Background:
Pediatric Long COVID is an emerging but still under-recognized condition in general practice. Children affected by post-COVID symptoms often present with fatigue, cognitive disturbances, post-exertional intolerance, and significant functional decline, yet remain clinically invisible.

Research questions:
This study aims to characterize pediatric Long COVID through a case-based approach, using semantic standardization via the Human Phenotype Ontology (HPO).

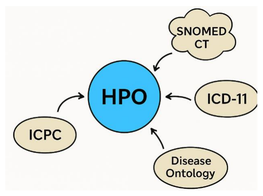
Method:
Out of a cohort of 307 patients followed in general practice for Long COVID between 2021 and 2025, ten children aged 6 to 15 (7 female) were selected as the youngest subgroup. Each case was assessed using a multimodal protocol combining standardized questionnaires (ComPaRe and COOP/WONCA), recorded clinical interviews, and HPO-based semantic symptom extraction. The approach emphasized lived experience, narrative analysis, and functional assessment.

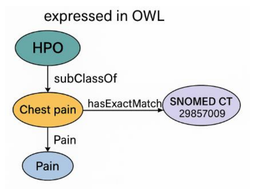
Each concept is defined by a Uniform Resource Identifier (URI) and made accessible online via a Persistent URL (PURL), enabling interoperability with other ontologies such as Orphanet

Child's expression	Symptom	HPO
"My chest hurts."	Chest pain	HP:0100749
"My heart is beating faster and faster."	Palpitations	HP:0001962
"I realize that I fainted."	Syncope	HP:0001279
"Sometimes I say 1+1=3; the next day it's fine."	Cognitive fluctuations	HP:0033630
"I get too tired, so I stop."	Fatigability	HP:0003388
"After playing, I have to lie down."	Post-exertional fatigue	HP:0009020

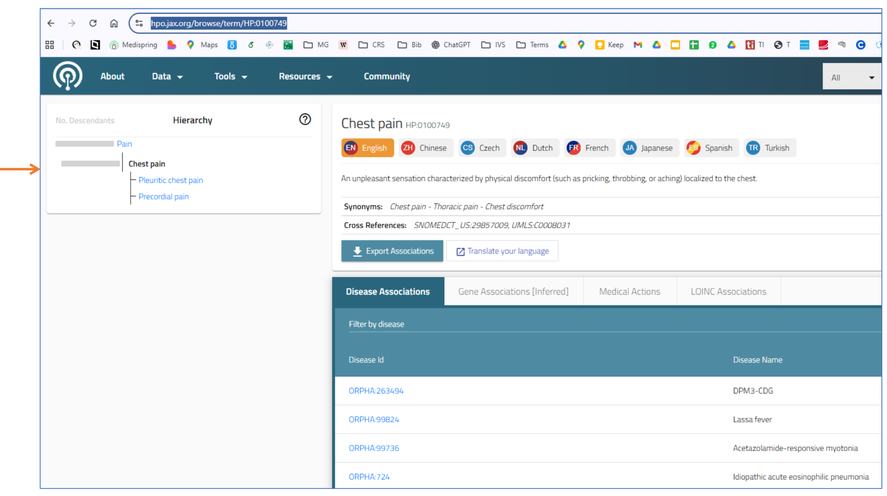
Concepts are extracted from narratives by a large language model (LLM).

Persistent URL(PURL)
https://hpo.jax.org/browse/term/HP:0100749

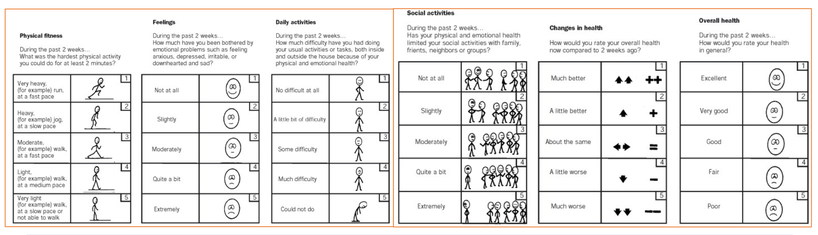




HPO URIs, expressed in Web Ontology Language (OWL), are linked to other ontologies through linked data platforms.



HPO, Initially designed by geneticists to aid in rare disease identification (**Robinson et al., 2008**),.



The functional status of each child was evaluated using the COOP-WONCA charts on-line, a standardized tool for measuring functional health and daily activity levels in primary care.

Understanding the patient's world through language, data, and ontology.

Results:
All ten children displayed a complex, multisystem symptomatology—most commonly fatigue and post-exertional intolerance (10/10), cognitive complaints (8/10), sleep disturbances, various types of pain, and signs of dysautonomia. Functional impairment was marked, with significant limitations across physical, cognitive, and social domains. HPO indexing enabled the transformation of narrative symptoms into reproducible phenotypic profiles, supporting both clinical decision-making and patient-family communication.

From narrative medicine to structured data: leveraging ChatGPT to extract symptom concepts from patient narratives using ontology-based standardization.

Children's recorded sentences, met in GP/FM consultation

- I'm tired all the time.
- I feel exhausted after any effort.
- I have no energy left, not even for simple things.
- She would get tired quickly and needed to rest often. What happens after exertion ? I'm totally drained.
- I have to take breaks between movements. I sleep, but I still wake up tired.https://docpatient.net/
- I used to do sports — now I can't even stay on my feet. She spends all her time sleeping in class.
- I can sleep for three days straight. . . or not at all for three days. I could sleep from 7 p.m. to noon, and still wake up tired.
- Before, I only slept at night — now I sleep all the time. Even a small effort can cause overwhelming fatigue. . .
- . . .forcing me to sleep no matter what.
- You sleep a lot. How much ? 19 hours a day.

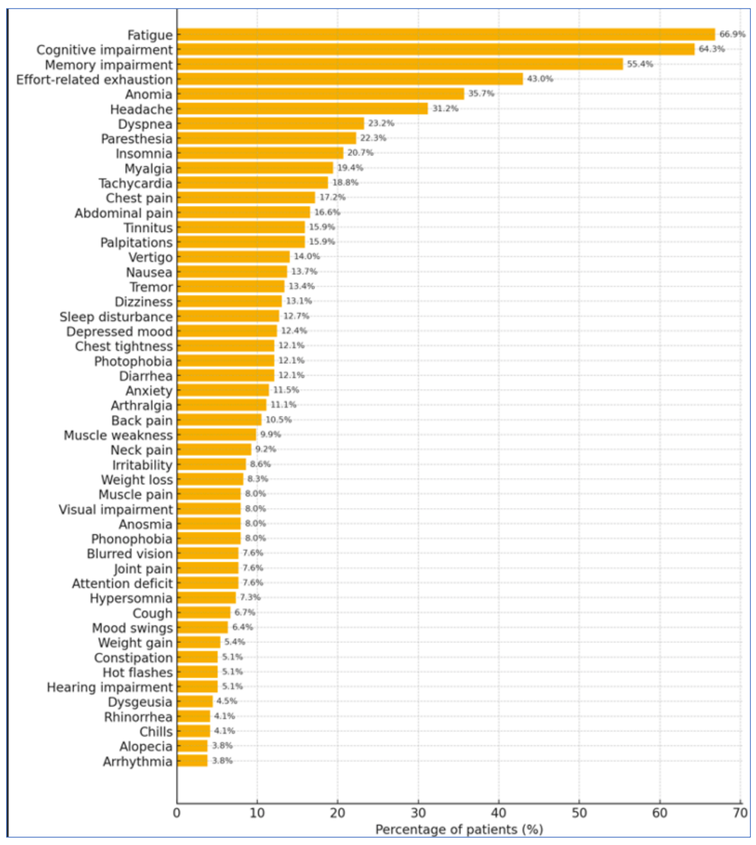
ChatGPT
https://chatgpt.com/

Humans speak to machines, which speak back to humans.

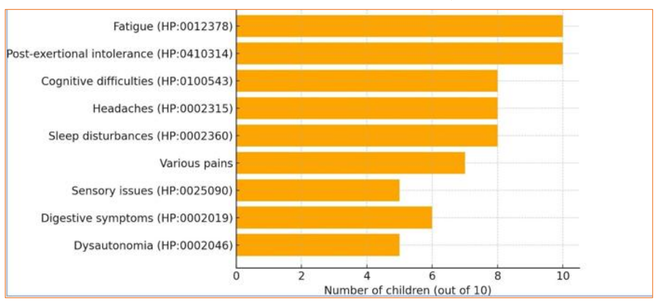
human phenotype ontology
https://hpo.jax.org/

Symptoms extracted from text by LLM + Human Phenotype Ontology

- Fatigue (HP:0012378) [I'm tired all the time]
- Fatigability (HP:0003388) [I feel exhausted after any effort]
- Asthenia (HP:0001347) [I have no energy left, not even for simple things]
- Fatigability (HP:0003388) [She would get tired quickly and needed to rest often]
- Postexertional malaise (HP:0030973) [What happens after exertion ? I'm totally drained]
- Exercise intolerance (HP:0003546) [I have to take breaks between movements]
- Unrefreshing sleep (HP:0030201) [I sleep, but I still wake up tired]
- Reduced activity tolerance (HP:0033413) [I used to do sports — now I can't even stay on my feet]
- Hypersomnia (HP:0002189) [She spends all her time sleeping in class]
- Hypersomnia (HP:0002189) [I can sleep for three days straight]
- Insomnia (HP:0100785) [or not at all for three days]
- Hypersomnia (HP:0002189) [I could sleep from 7 p.m. to noon, and still wake up tired]
- Hypersomnia (HP:0002189) [Before, I only slept at night — now I sleep all the time]
- Postexertional malaise (HP:0030973) [Even a small effort can cause overwhelming fatigue]
- Hypersomnia (HP:0002189) [forcing me to sleep no matter what]
- Hypersomnia (HP:0002189) [You sleep a lot. How much ? 19 hours a day]



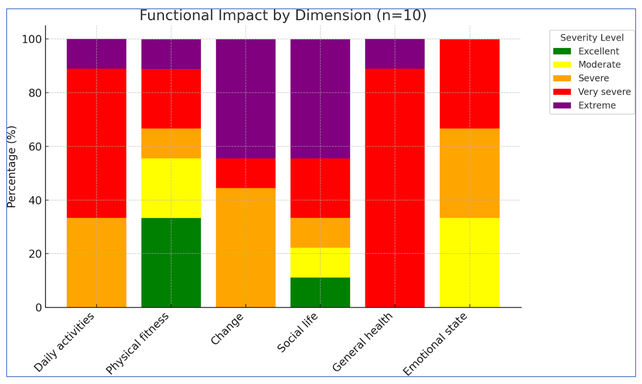
HPO terms extracted through a uniform pipeline (questionnaires + recorded interview + HPO semantic mapping) in 307 patients including the ten kids (67% F). Bars show number of patients per term; multiple terms per patient possible.



Mapping the prevalence of Long COVID symptoms in 10 kids (7 f, 3 m) using HPO indexing

From symptoms to meaning: describing a new disease.

The children are struggling deeply, none are able to attend school.



Functional status of children — COOP-WONCA assessment

Conclusions:

This study highlights the potential of general practice to detect and document pediatric Long COVID using a narrative and phenotypic approach.

By integrating patient stories with digital semantic tools like HPO, clinicians can give structure and legitimacy to subjective complaints, facilitating earlier recognition and better care for affected children.

Points for discussion:

- An innovative way to make narrative medicine a tool for everyday clinical practice
- This work highlights the importance of the added value of technologies that enable faithful, shareable, and reusable documentation during consultation while partnering with patients
- This approach aims to reaffirm the central role of primary care in identifying, validating, and supporting pediatric forms of Long COVID, through an alliance between clinical practice, language, and technology
- By combining clinical listening, computerized structuring of symptoms, and the active involvement of the patient and their family, it becomes possible to give shape to experiences that are often fragmented

"The owl, nocturnal messenger, carries both knowledge and doubt. "

Sources:

Research report on Long Covid 2021-2025

Zotero bibliography on Long Covid

Presentation on HPO in Long Covid

This poster

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