Acetaminophen and Neurodevelopment

The Role of Acetaminophen in the Development of Autism Spectrum Disorder (ASD)

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Suggested Visual:

Image of vintage acetaminophen bottles from the 1950s.

Slide 1: Acetaminophen, a widely used medication since the 1950s, gained popularity for treating pain and fever.

Suggested Visual:

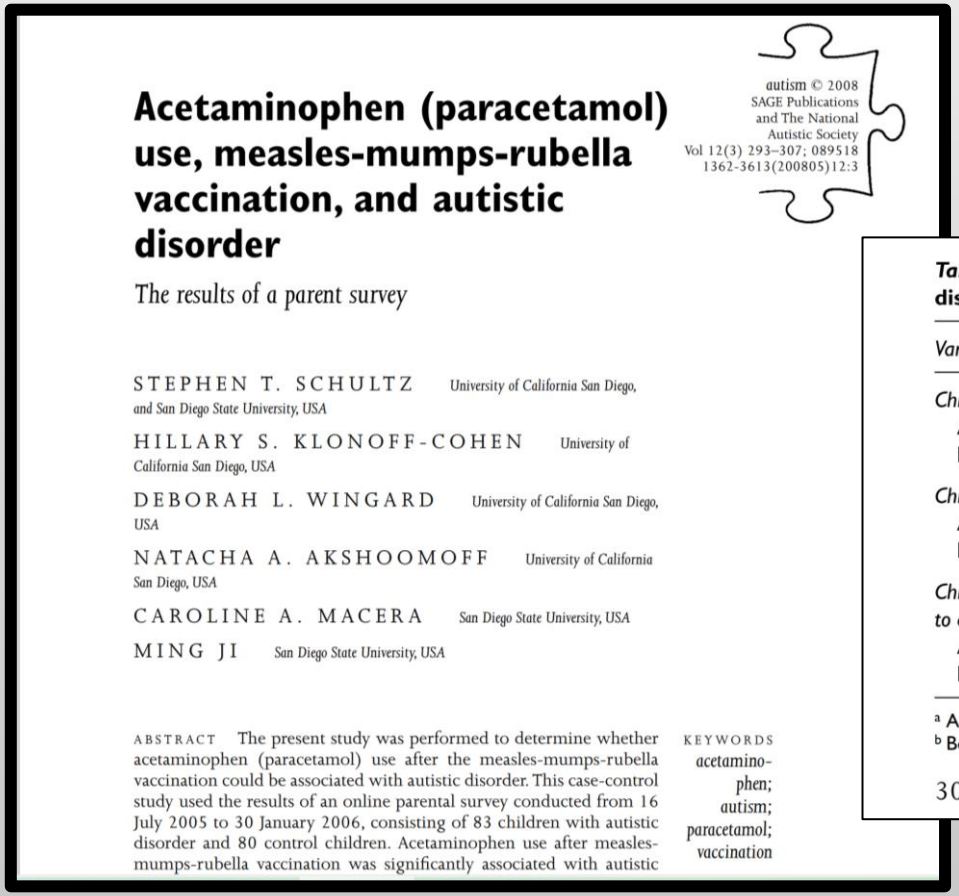
Timeline of the evolution of acetaminophen packaging over the decades, indicating that the use of aspirin decreased with the increase in the use of acetaminophen.

Slide 2: Initially considered safe for pediatric use, acetaminophen became a primary choice following concerns about aspirin and the Reye Syndrome.

Suggested Visuals:

a) Cover page of the research paper by Stephen Schultz et al.

b) Table highlighting the odds ratio of 20.9.



Acetaminophen (paracetamol) use, measles-mumps-rubella vaccination, and autistic disorder

The results of a parent survey

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ABSTRACT The present study was performed to determine whether acetaminophen (paracetamol) use after the measles-mumps-rubella vaccination could be associated with autistic disorder. This case-control study used the results of an online parental survey conducted from 16 July 2005 to 30 January 2006, consisting of 83 children with autistic disorder and 80 control children. Acetaminophen use after measles-mumps-rubella vaccination was significantly associated with autistic

KEYWORDS *acetamino-phen; autism; paracetamol; vaccination*

Table 3 **Adjusted[a] associations of analgesic use age 12–18 months with autistic disorder, 2005–6**

Variable (n = cases, controls)	*Odds ratio*	*95% CI*	*p-value[b]*
Children 1–18 years			
Acetaminophen (70, 67)	8.37	2.08–33.7	**0.003**
Ibuprofen (49, 53)	2.17	0.82–5.72	0.119
Children 1–5 years			
Acetaminophen (23, 23)	5.29	0.99–28.3	0.052
Ibuprofen (16, 19)	1.23	0.22–6.85	0.810
Children 1–18 years, cases limited to children with regression			
Acetaminophen (26, 67)	20.9	1.33–32.9	**0.031**
Ibuprofen (20, 53)	2.14	0.63–9.54	0.199

[a] Adjusted for age, gender, and moth[illegible]s ethnicity.
[b] Bold type denotes significance.

300

Slide 3: However, in 2008, a study by Stephen Schultz et al. revealed a 20-times greater risk of regressive Autism Spectrum Disorder (autism) in children using acetaminophen between 12 and 18 months.

Suggested Visual:

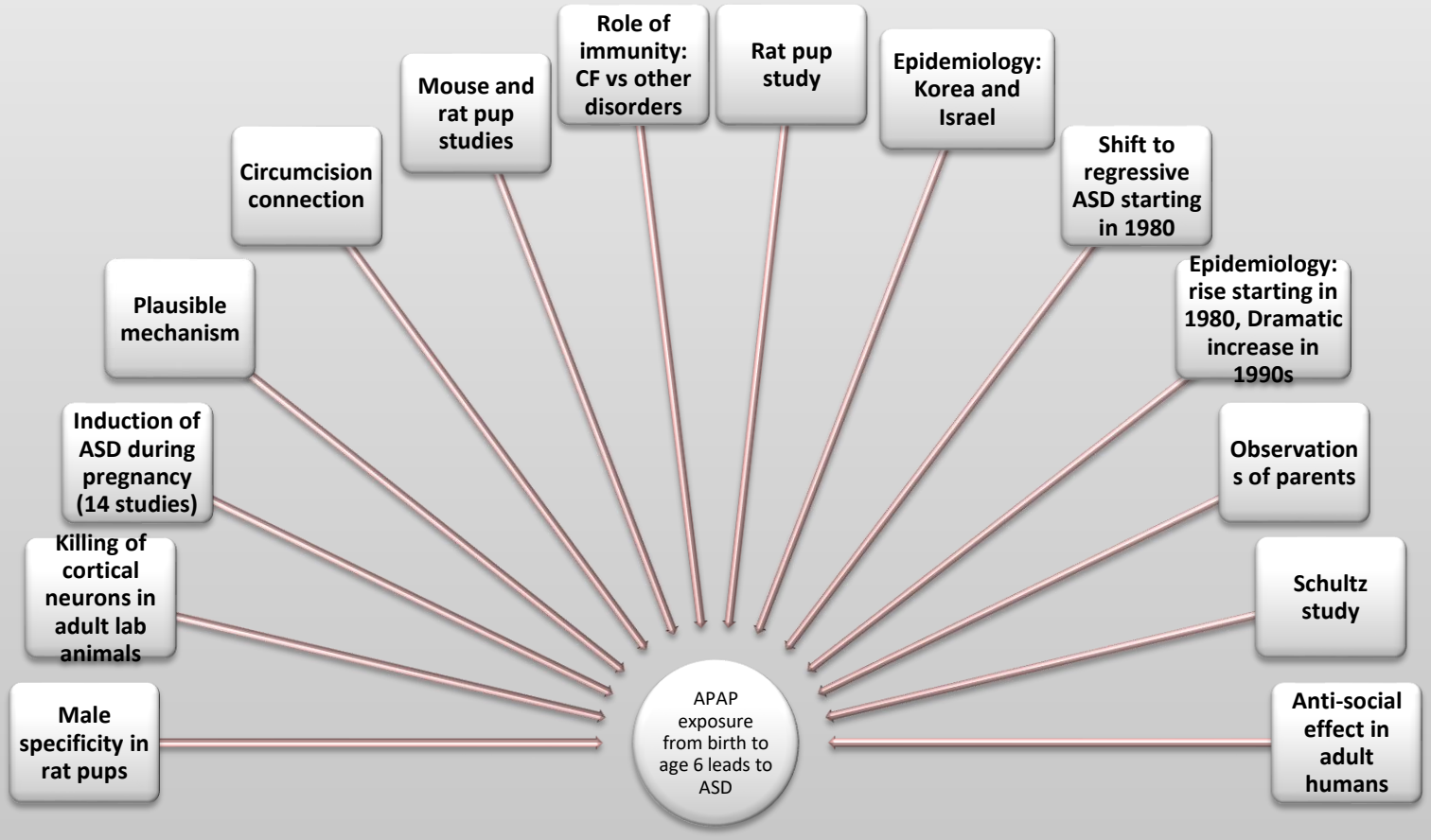
List of 22 lines of evidence pointing out acetaminophen use as a cause of autism.

[Table 1 from the article published in the journal *Children*: *The Dangers of Acetaminophen for Neurodevelopment Outweigh Scant Evidence for Long-Term Benefits* - PubMed (nih.gov)]

Slide 4: By 2022, growing evidence pointed conclusively to acetaminophen as a cause of many, if not most, cases of autism. As of 2023, 22 total lines of evidence supported this conclusion.

Suggested Visual:

Evidence diagram showing the links between acetaminophen use and autism.

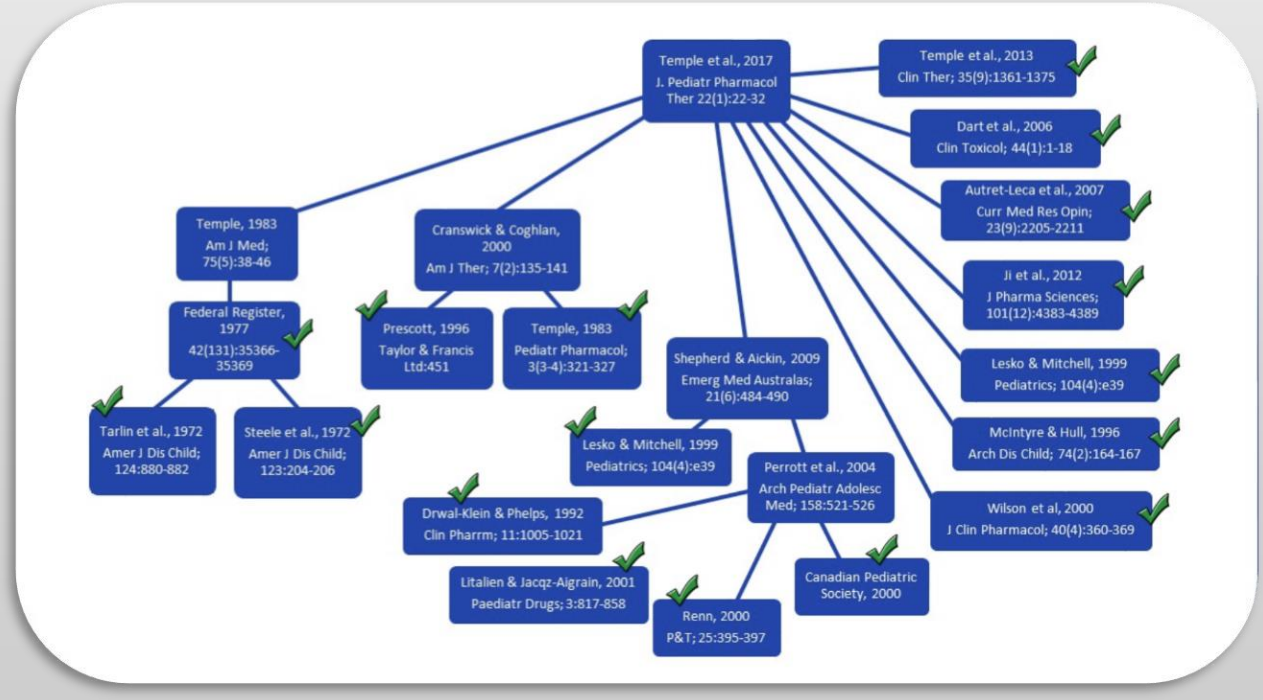


Slide 5: Evidence highlighted numerous associations linking acetaminophen use during early neurodevelopment to autism

Suggested Visual:

Bubble graph of all the papers that claimed acetaminophen to be safe.

Systematic tracking of studies which claimed acetaminophen to be safe brought to light the fact that none of the experiments conducted in those studies consclusively demonstrated safety.

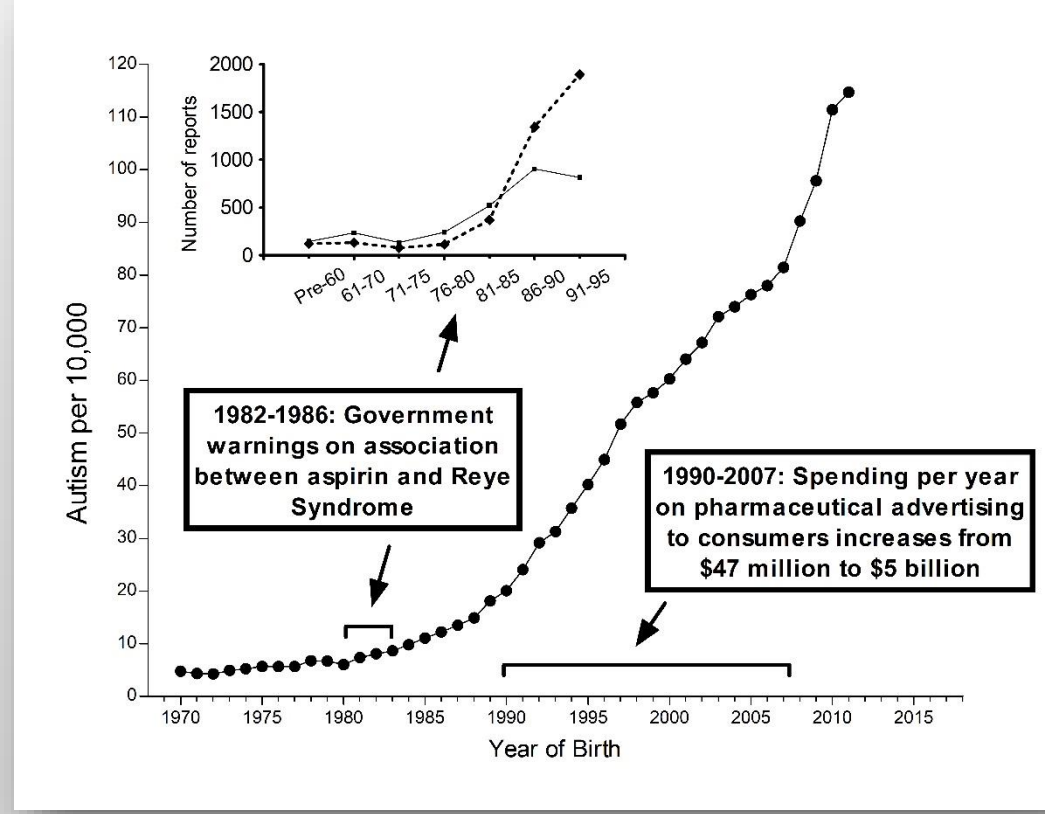


Slide 6: Acetaminophen was never proven to be safe for babies and children.

Figure reference: Figure 1 from https://pubmed.ncbi.nlm.nih.gov/35175416/

Suggested Visual:

Diagram linking early neurodevelopment to autism with the increased use of acetaminophen.



Slide 7: A dozen independent associations that connect acetaminophen and autism include findings involving circumcision, South Korean children's product discrepancies, and changes in autism prevalence, coinciding with the increased use of acetaminophen.

Figure reference: adapted from Figure 2 of https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5536672/

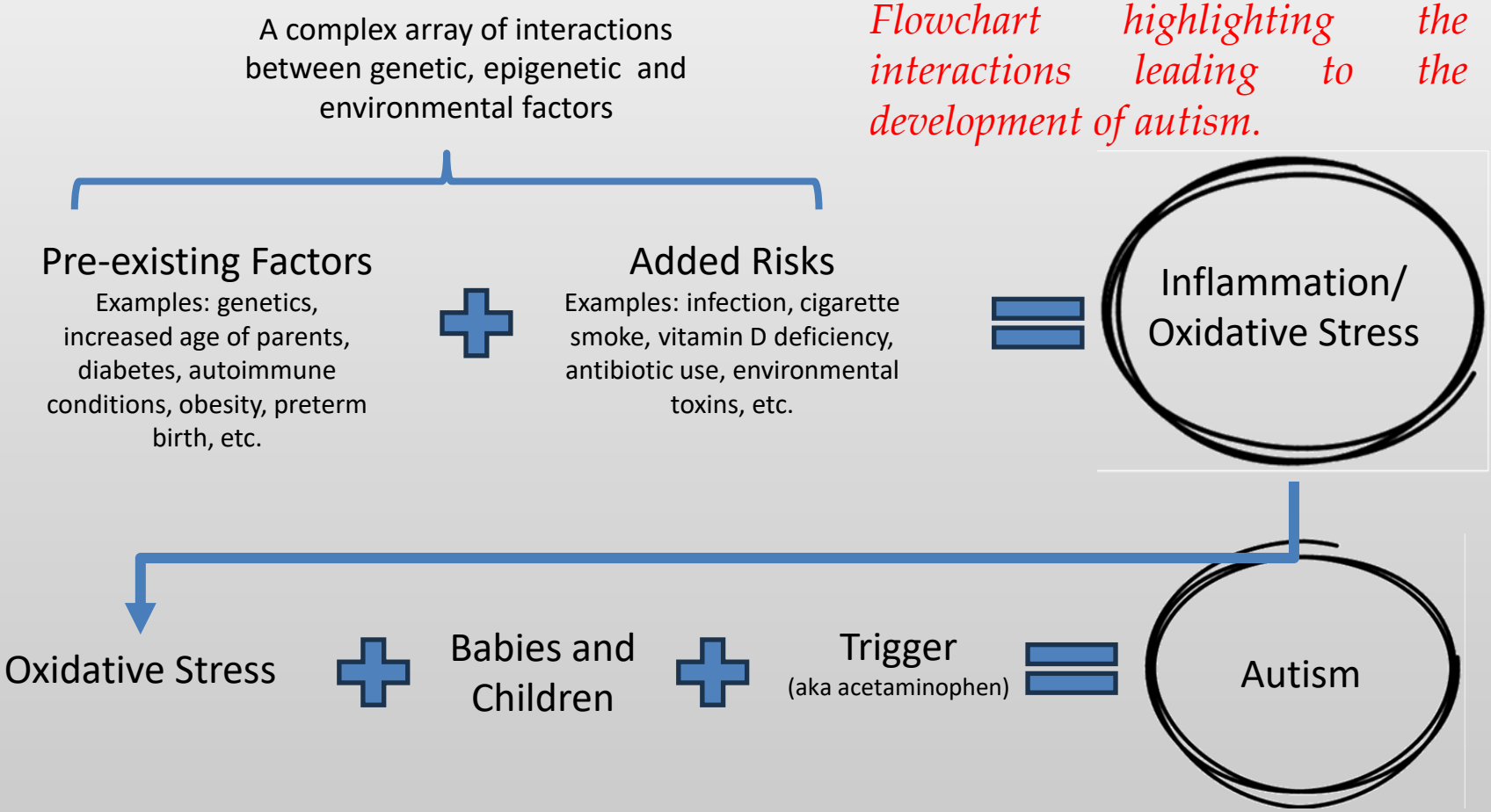
Suggested Visual:

Images of previous/ongoing laboratory studies.

Slide 8: Numerous laboratory studies investigating the interaction between acetaminophen and the body supported this conclusion.

Suggested Visual:

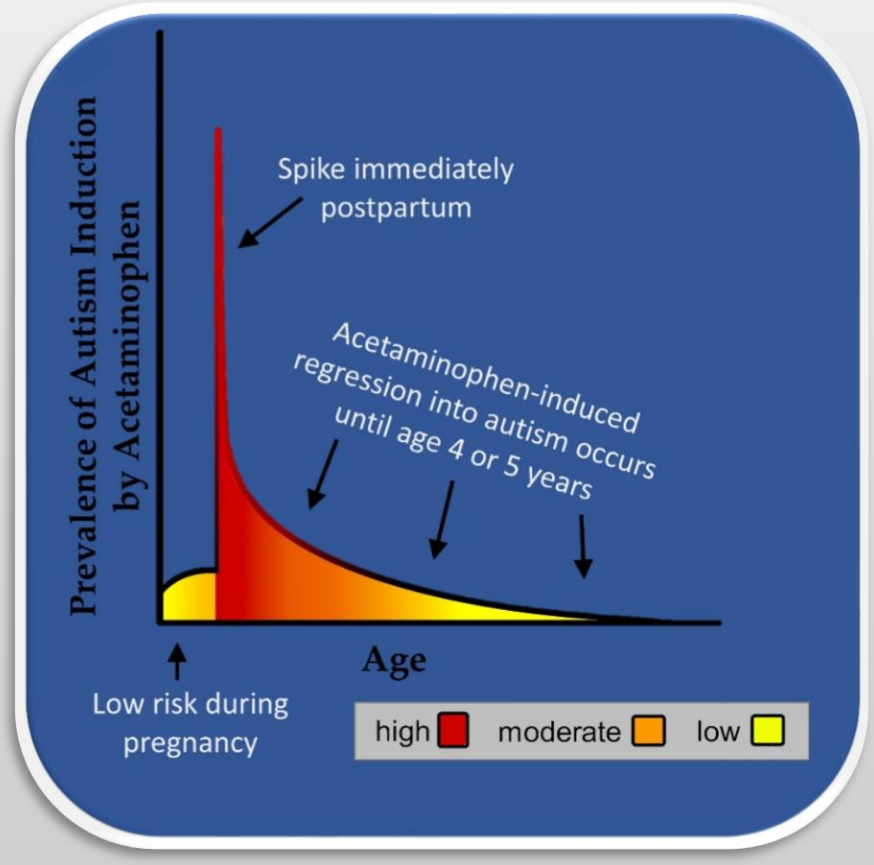
Flowchart highlighting the interactions leading to the development of autism.



Slide 9: While most babies and children exposed to acetaminophen do not develop autism, oxidative stress creates susceptibility to drug-induced injury. Oxidative stress can be caused by a variety of factors, including genetics, antibiotic use, infections, environmental toxins, and more.

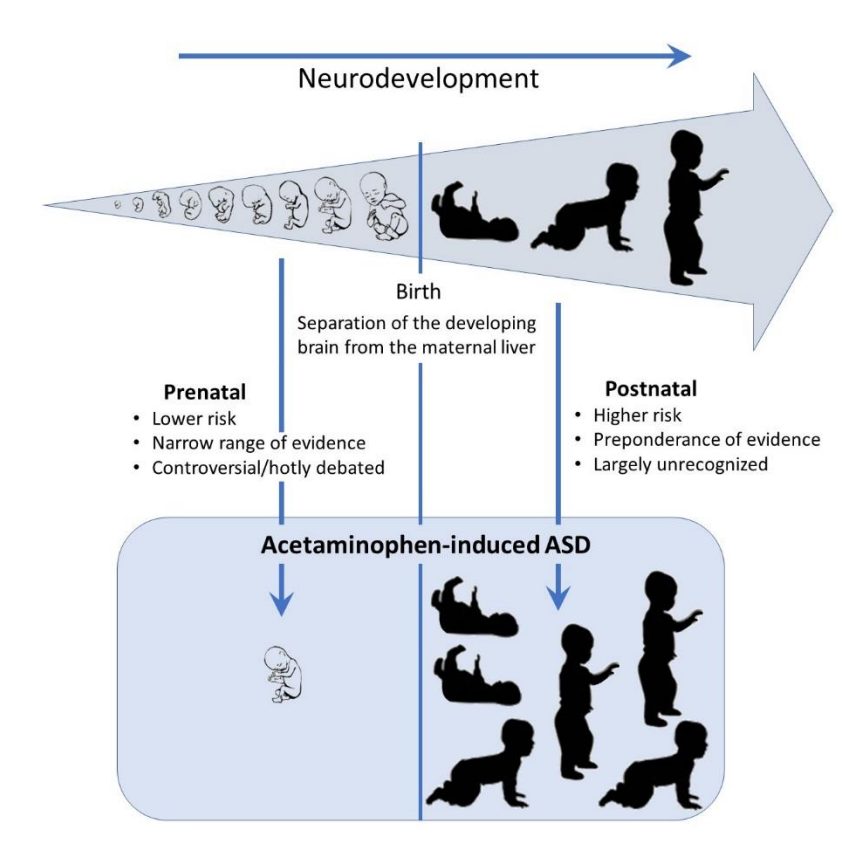
Suggested Visual:

Graph highlighting the early neurodevelopmental spike.



Slide 10: The time period when a baby's brain is sensitive to acetaminophen may start early in pregnancy, but the birth period is more critical. Newborns, particularly within the first 10 days, are highly sensitive due to their limited ability to process drugs.

Figure reference: Figure 2 from https://pubmed.ncbi.nlm.nih.gov/38255358/



Suggested Visual:

Stages of neurodevelopment in babies: from crawling to walking.

Slide 11: This sensitivity to acetaminophen extends beyond infancy, into early childhood, as seen by regressive autism, which is when the onset of autism occurs as children lose mental development.

Figure reference: graphical abstract for https://pubmed.ncbi.nlm.nih.gov/37321575/

Suggested Visual:

Graphical image of follow-up safety studies.

All studies supposedly demonstrating safety were short-term studies, which focused on liver functions and not neurological functions.

Slide 12: Despite proof that acetaminophen was never shown to be safe for brain development, the consensus that acetaminophen is safe for babies and children persists.

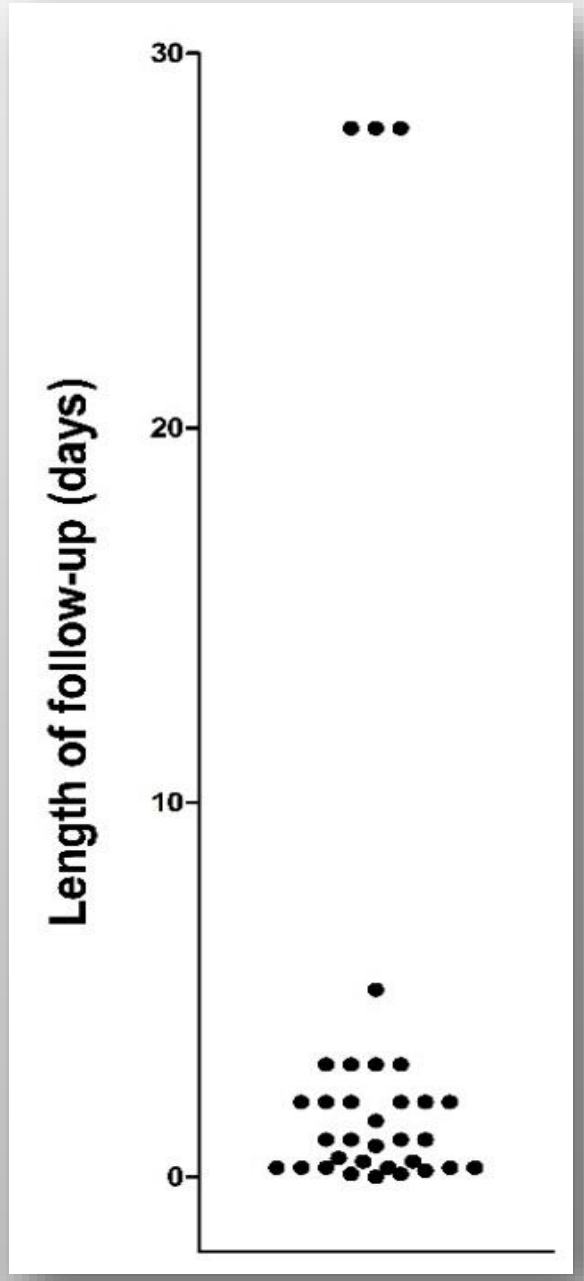
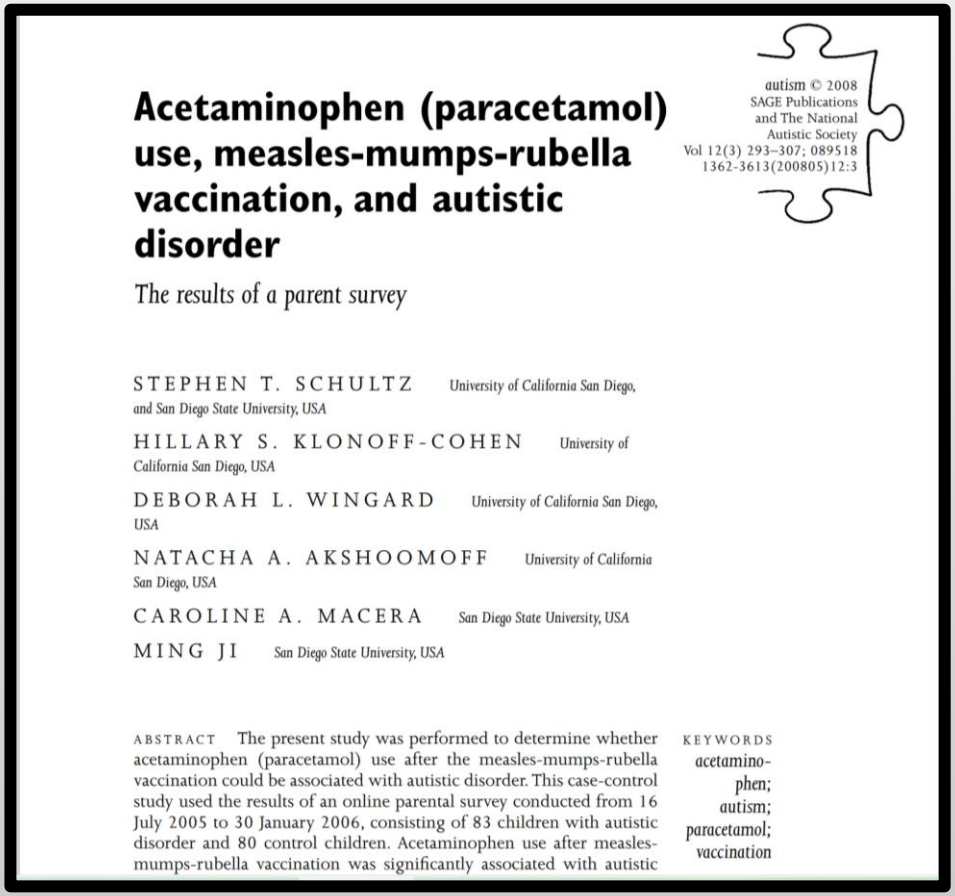


Figure reference: Figure 2 from https://pubmed.ncbi.nlm.nih.gov/35175416/

Suggested Visual:

The study by Schultz et al.



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KEYWORDS
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Slide 13: The initial 2008 report by Schultz faced skepticism.

Suggested Visual:

Other studies stating the use of acetaminophen to be not safe.

[Animate a long list of supporting studies. Here are great examples:]

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4530408/pdf/10.1177_0141076814565942.pdf
https://pubmed.ncbi.nlm.nih.gov/18445737/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6822099/
https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0015360&type=printable
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3534986/pdf/nihms428627.pdf
https://pubmed.ncbi.nlm.nih.gov/10435209/
https://pubmed.ncbi.nlm.nih.gov/28415925/
https://pubmed.ncbi.nlm.nih.gov/34170958/
https://pubmed.ncbi.nlm.nih.gov/24361869/
https://pubmed.ncbi.nlm.nih.gov/10435209/
https://www.wplaboratory.org/_files/ugd/119c83_52a241354b274586bf8c2a82d79ecb70.pdf
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9056471/
https://pubmed.ncbi.nlm.nih.gov/29910617/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC340185/pdf/20030600s00030p509.pdf
https://pubmed.ncbi.nlm.nih.gov/31001155/
https://pubmed.ncbi.nlm.nih.gov/25189402/
https://www.wplaboratory.org/_files/ugd/119c83_52a241354b274586bf8c2a82d79ecb70.pdf
https://pubmed.ncbi.nlm.nih.gov/28415925/
https://pubmed.ncbi.nlm.nih.gov/34046850/
https://pubmed.ncbi.nlm.nih.gov/18445737
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https://pubmed.ncbi.nlm.nih.gov/28415925/
https://www.wplaboratory.org/_files/ugd/119c83_52a241354b274586bf8c2a82d79ecb70.pdf
https://www.wplaboratory.org/_files/ugd/119c83_52a241354b274586bf8c2a82d79ecb70.pdf

Slide 14: Along with that, numerous other studies that stated acetaminophen to be not safe were also largely ignored.

Suggested Visual:

The categories of recommended change.

*Category 1: **Administration of acetaminophen in a manner that was never intended should be discontinued.***

*Category 2: **Administration of acetaminophen under conditions in which evidence demonstrates a lack of effectiveness should be discontinued.***

*Category 3: **Administration of acetaminophen under conditions in which no evidence demonstrates long-term benefits of treatment or in which evidence demonstrates a lack of long-term benefits should be discontinued.***

*Category 4: **Administration of acetaminophen that is no longer recommended by governing medical bodies should be discontinued.***

*Category 5: **Administration of acetaminophen under conditions where evidence indicates that it is or may be beneficial should not be continued without disclosure of the drug's long-term risks for neurodevelopment. All caregivers, including parents, should be made aware of evidence related to both benefits and risks so that they can make informed decisions.***

Slide 15: Several advocates, such as Parker et al., call for regulatory restrictions on pediatric acetaminophen use and emphasize the need for education to all parents and caregivers.

Text reference: https://pubmed.ncbi.nlm.nih.gov/38255358/