Adenoidectomy & Tonsillectomy in Children: From Anatomy to Long-term Consequences

Presenter : PGY 1 陳瑢

Supervisor: Attending 洪偉誠醫師

“一個5歲女童，媽媽主訴打鼾、
張口呼吸、
反覆中耳炎、
學習注意力差”
→ 小兒科轉介ENT
→ What's the next step?

400,000 – 600,000

T&A procedures per year in the US

Most common major surgery in children

Hall MJ, Schwartzman A, Zhang J, Liu X. Ambulatory Surgery Data From Hospitals and Ambulatory Surgery Centers: United States, 2010. Natl Health Stat Report. 2017 Feb;(102):1-15.

1.

Anatomy & Pathophysiology of Adenoid and tonsil

2.

Indications & Contraindications

Adenoidectomy/tonsilectomy

3.

Long-term Risk?

Home | JAMA Otolaryngology–Head & Neck Surgery | Vol. 144, No. 7

Original Investigation FREE

Association of Long-Term Risk of Respiratory, Allergic, and Infectious Diseases With Removal of Adenoids and Tonsils in Childhood

Sean G. Byars, PhD[1,2]; Stephen C. Stearns, PhD[3]; Jacobus J. Boomsma, PhD[2]

» Author Affiliations | Article Information

4.

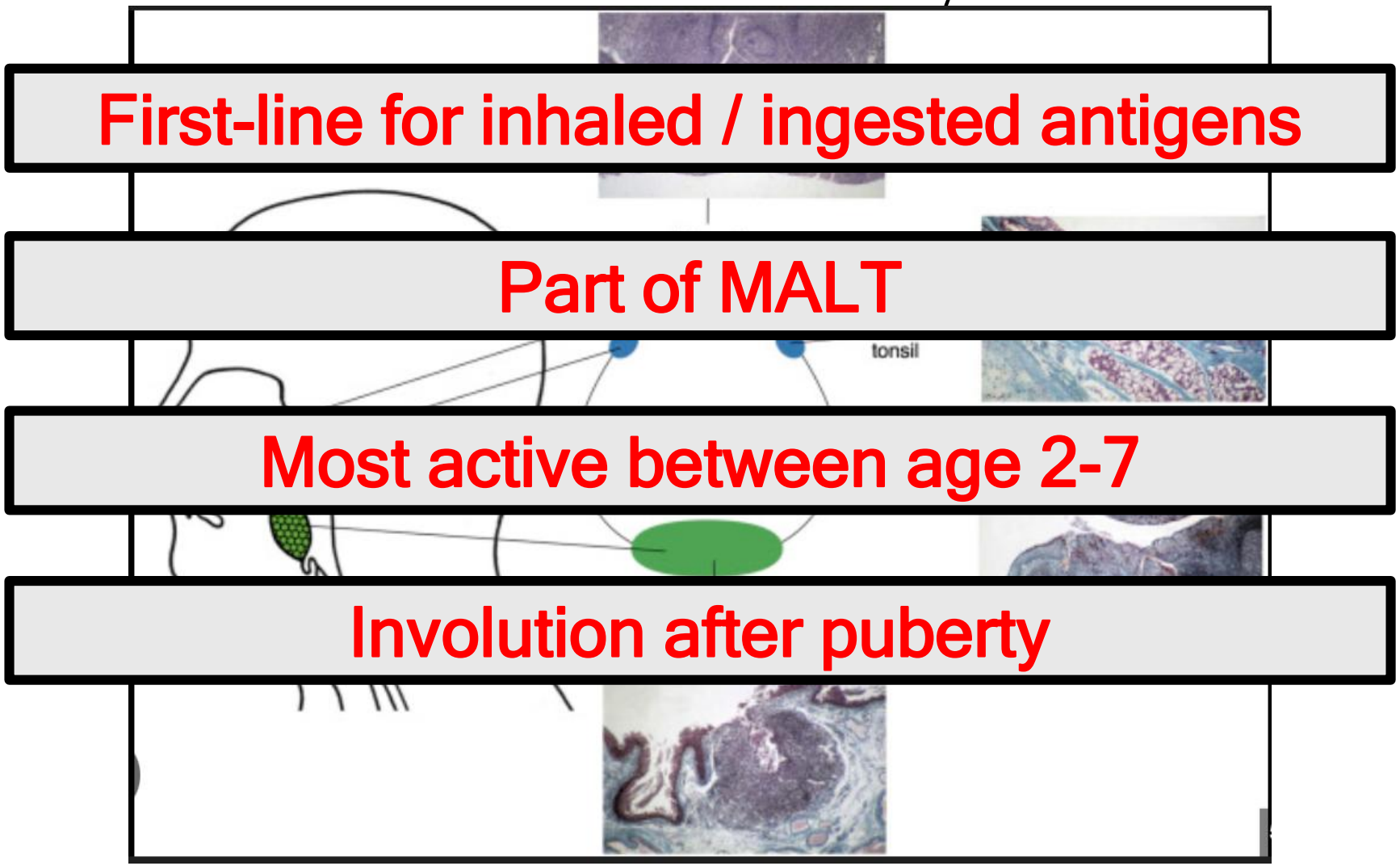
Clinical Apprasal & Discussions

1.

Anatomy & Pathophysiology of Adenoid and tonsil

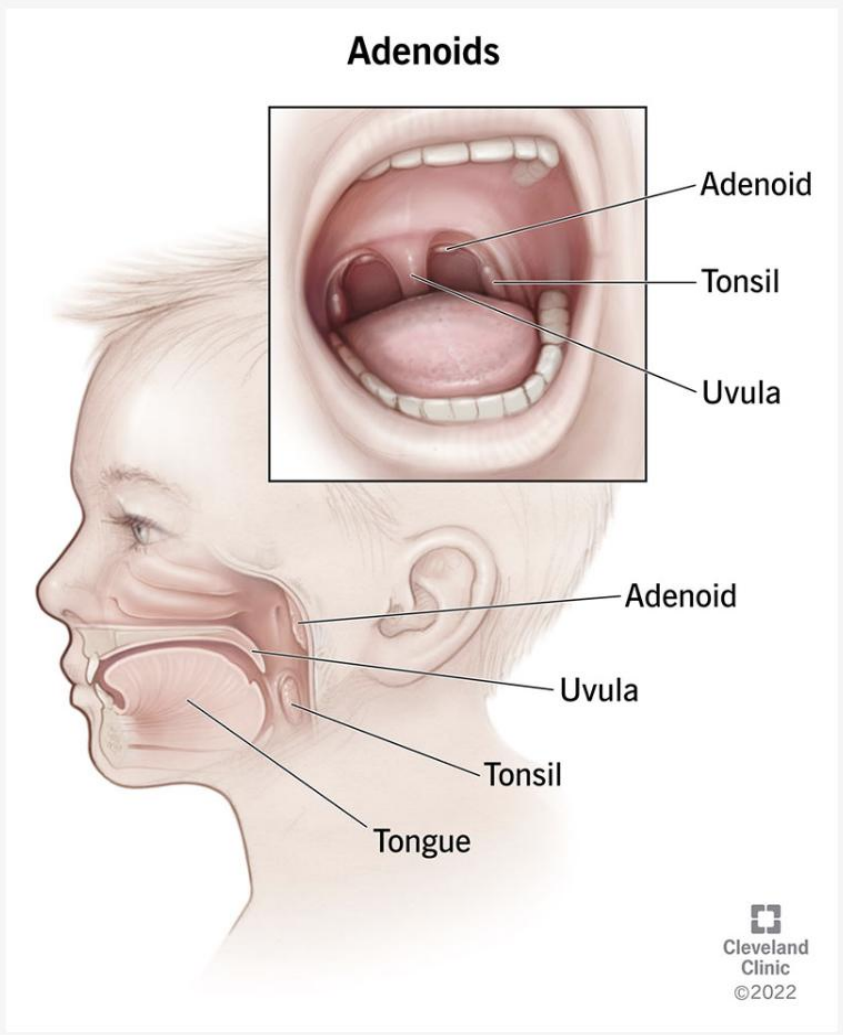
Waldeyer's Ring

The immune Gateway



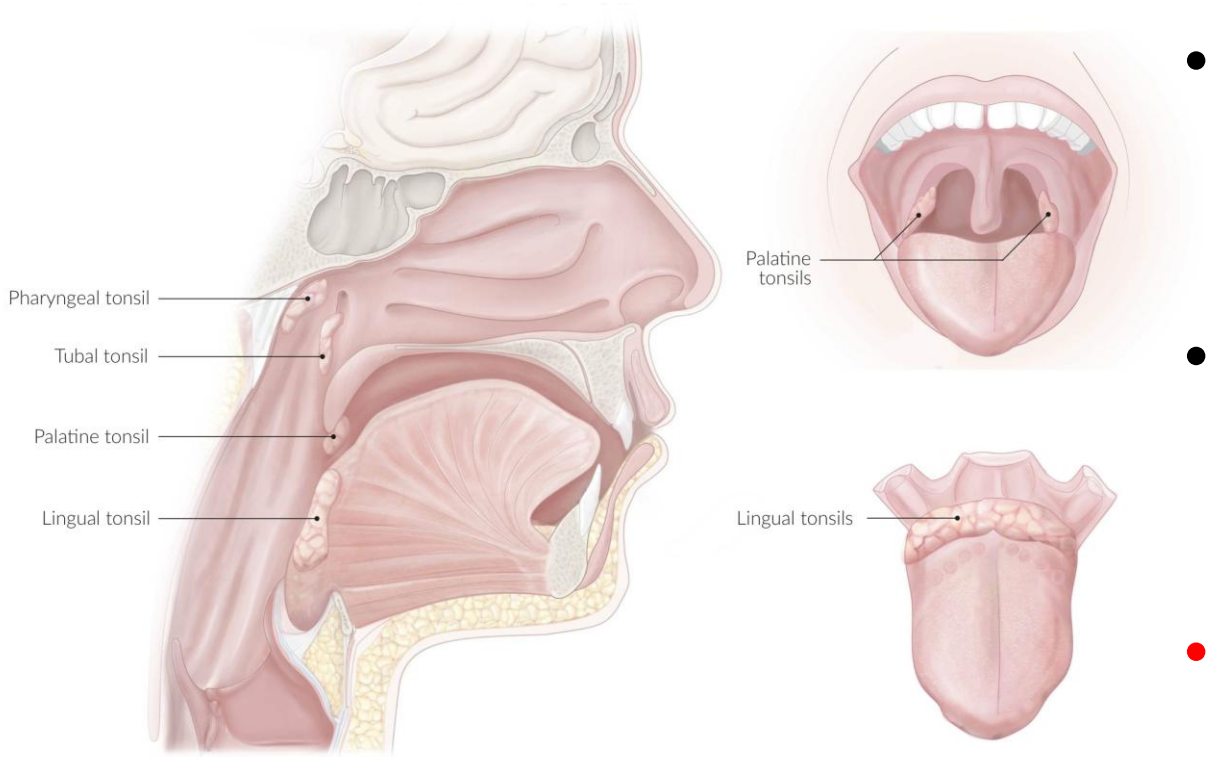
Perry, M., Whyte, A., 1998. Immunology of the tonsils. Immunol. Today 19 (9), 414-421.

Adenoid (Pharyngeal tonsil)



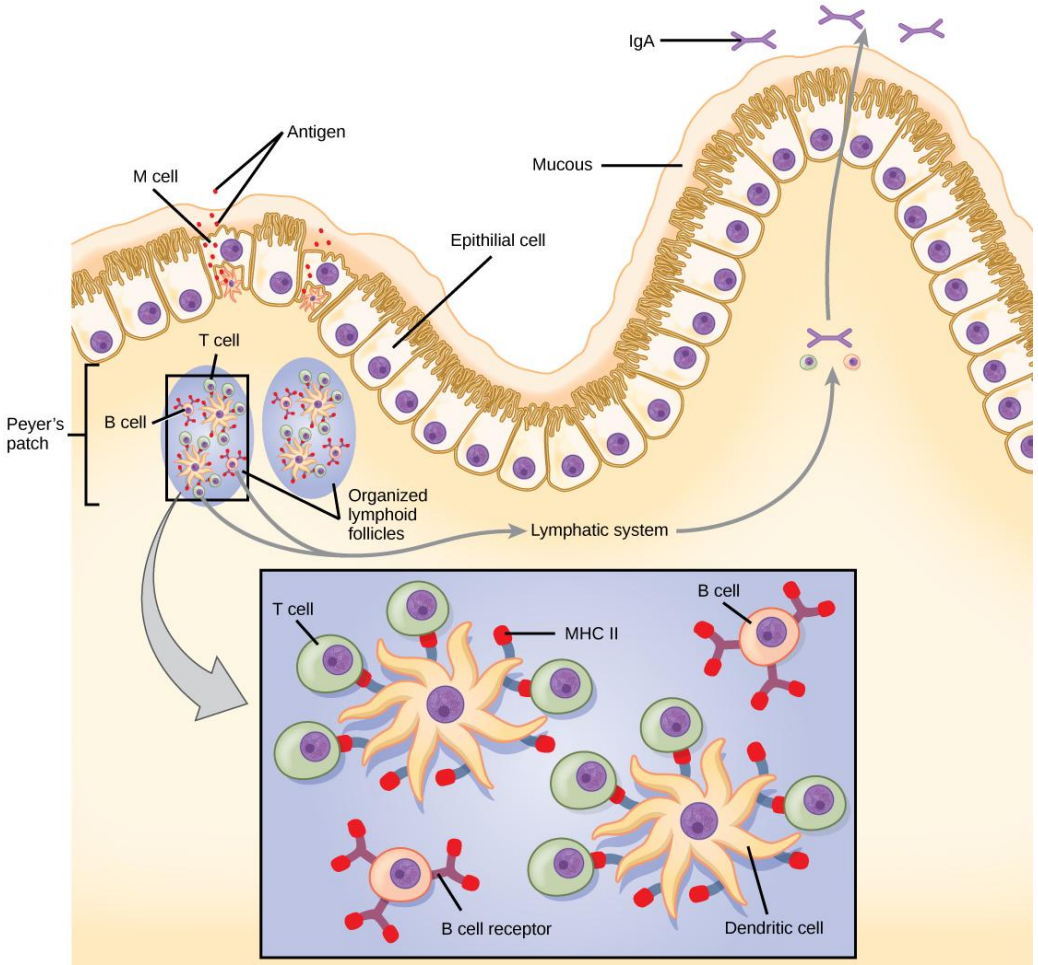
- Grow to maximum size between ages 3 and 5.
- Start to shrink by age 7 or 8.
- MALT
- Located in roof and posterior wall of the nasopharynx
- **no crypts**, only **small folds of mucosa**
- **Lateral to opening of ET tube**

Tonsil (Palatine tonsil)



- Between the **palatoglossal** and **palatopharyngeal arches**
- **Covered by nonkeratinized stratified squamous epithelium.**
- **Contains 10–20 deep, branched crypts**

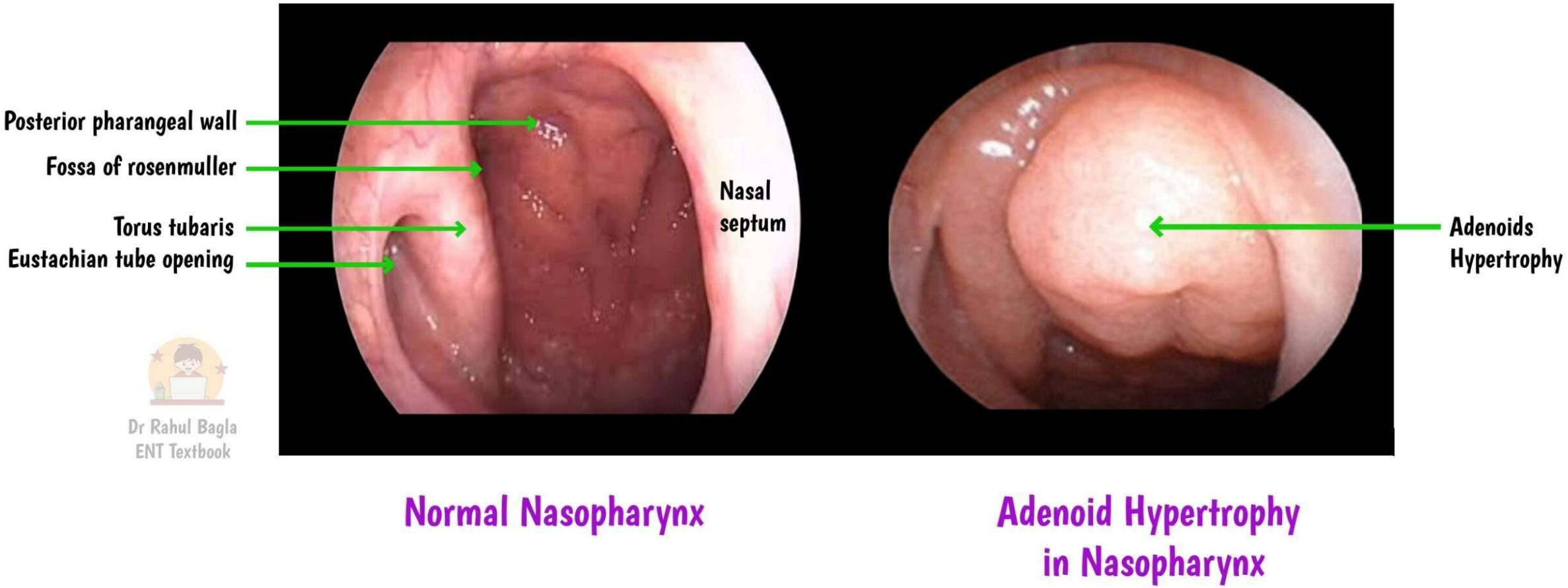
Immunity inside adenoid



- Contains
  - the cryptepithelium (with M cells for antigen uptake), germinal centers, mantle zones, and interfollicular areas
- T cell response -> helper T cell
- B cell response -> isotype switching (IgA and IgG)

van Kempen MJ, Rijkers GT, Van Cauwenberge PB. The immune response in adenoids and tonsils. Int Arch Allergy Immunol. 2000 May;122(1):8-19. doi: 10.1159/000024354. PMID: 10859465.

Adenoid hypertrophy



Adenoid hypertrophy: Who is easier to have AH

> Int J Pediatr Otorhinolaryngol. 2007 May;71(5):713-9. doi: 10.1016/j.ijporl.2006.12.018.

Clinical Trial > Biomed Res Int. 2013:2013:629607. doi: 10.1155/2013/629607. Epub 2013 Sep 23.

Microbiological profile of adenoid hypertrophy correlates to clinical diagnosis in children

Anita Szalmás [1], Zoltán Papp, Péter Csomor, József Kónya, István Sziklai, Zoltán Szekanecz, Tamás Karosi

Affiliations + expand

PMID: 24175295 PMCID: PMC3794625 DOI: 10.1155/2013/629607

Affiliations + expand

PMID: 25758194 DOI: 10.1016/j.ijporl.2015.02.017

- **Children with allergic rhinitis** are more likely to develop AH
- especially those who are polysensitized to aeroallergens such as molds and house dust mites.

- **Children** with recurrent infections (bacterial and viral)
- Haemophilus influenzae, Staphylococcus aureus, Streptococcus pneumoniae, and Moraxella spp., as well as the presence of bacterial biofilms

Ans:
Those with allergic rhinitis (especially with polysensitization), exposure to cigarette smoke, a family history of adenoid hypertrophy, younger age, recurrent respiratory infections, and obesity

Tonsil hypertrophy & Recurrent tonsilitis

- Tonsil hypertrophy
  - **repeated antigenic stimulation** from infectious (e.g., viral or bacterial) or noninfectious (e.g., allergen) triggers

- Recurrent tonsilitis
  - Definition: 5 or more episodes annually
  - M cell loss ➡☐ Uncontrolled antigen enti

➡☐ **excessive expansion of mature B-cell clones** but reduced formation of **IgA-producing B cells ➡☐ Impaired local immune function**

Nimmana BK, Paterek E. Tonsillitis. [Updated 2025 Jul 7]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-.

2.

Indications & Contraindications

Adenoidectomy/tonsilectomy

UpToDate®

Airway obstruction

Pediatric OSA

Tonsillar hypertrophy + PSG: AHI ≥1.5
Moderate-severe: AHI ≥3 (<12y) or ≥5 (≥12y)

Nasal Obstruction

Severe symptoms, chronic mouth breathing
Adenoid >80% nasopharyngeal space

Otitis Media w/ Effusion

Recurrent OME with hearing loss
Adjunct to tympanostomy tubes (age ≥4y)

Craniofacial

Adenoid facies, dental malocclusion
Obstructive sleep-disordered breathing

Infection

Recurrent Tonsillitis

Paradise criteria
=> Severe, affecting quality of life

PFAPA Syndrome

Periodic fever + pharyngitis + aphthous ulcers
+/- cervical lymphadenopathy

Peritonsillar Abscess

Recurrent PTA or after failed I&D
Consider tonsillectomy

Refractory CRS

Adenoidectomy after failed medical Rx
Especially in children <12 years

Tonsillectomy / Adenotonsillectomy

Recurrent tonsilitis / pharyngitis ➡☐ **Severely affected children**

- **Definition? ➡☐ Paradise Criteria**

Frequency	Time Period
≥ 7 episodes	1 year
≥ 5 episodes/year	2 consecutive years
≥ 3 episodes/year	3 consecutive years
(Severe criteria)	Any period

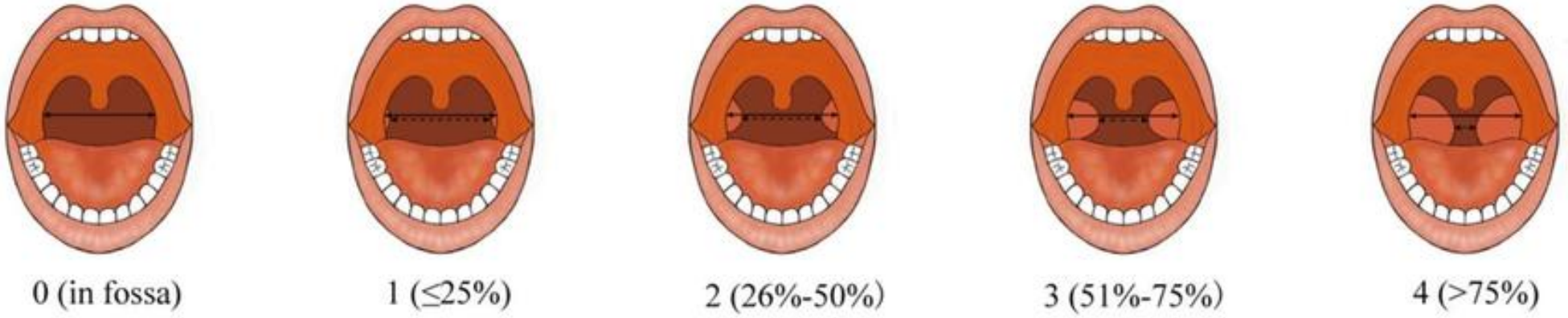
Episode Criteria (each episode must have ≥1)
Fever > 38.3°C
Cervical lymphadenopathy (tender, ≥2 cm)
Tonsillar exudate
Positive Group A Streptococcus culture or rapid antigen test

- SDM and individualized plan
  - Surgical and nonsurgical management are both provided

Adenotonsillectomy for OSA ⇒ clinical s/s +

Obstructive sleep apnea in children

- severe OSA (AHI ≥ 10) with relevant clinical symptoms: Adenotonsillectomy recommended
- Non-severe OSA (AHI 2~10): either adenotonsillectomy or watchful waiting are reasonable
- Adenoidectomy alone is not recommended for children with OSA



Brodsky Grading Scale

Adenoidectomy

- Adenoid hypertrophy ➡☐ Nasal obstruction
  - Rhinosinusitis, ETT dysfunction, or Otitis Media
  - Nasal obstruction:

    mouth breathing, hyponasal speech, impaired olfaction
  - Must be distinguished from allergic or infectious rhinitis/structural nasal disease
- **Severe obstructive symptoms: Adenotonsillectomy rec (eg. OSA)**
- Chronic otitis media with effusion
- Refractory Chronic sinusitis unresponsive to medical therapy.

Contraindications

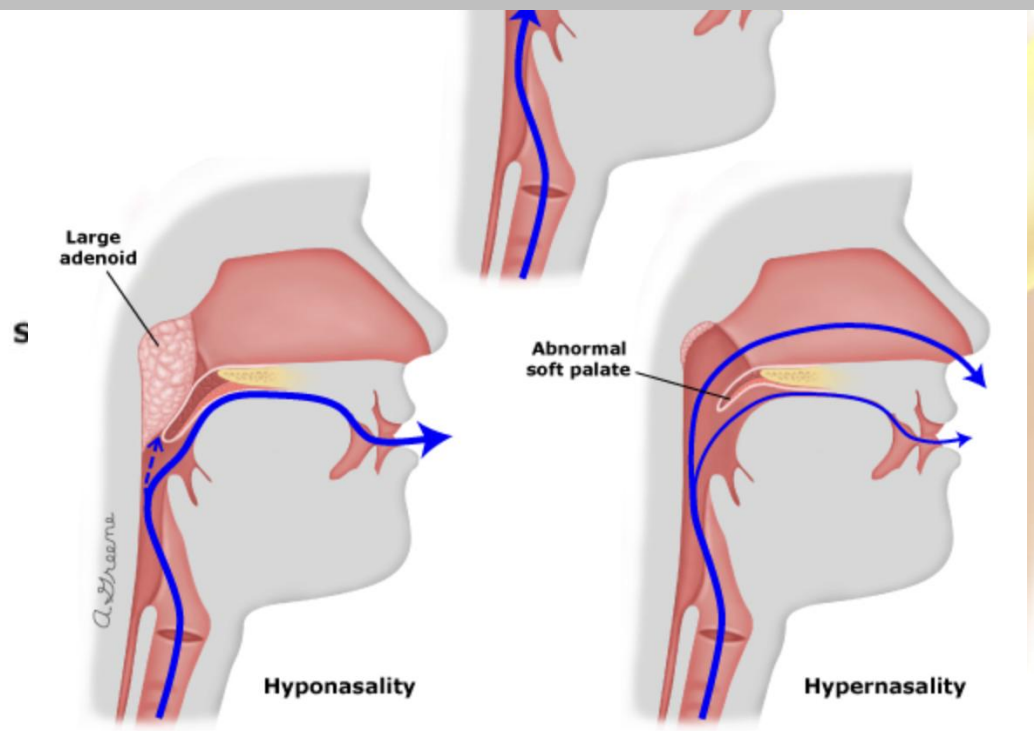
velopharyngeal insufficiency

- **Palatal Clefts:**
  - Overt cleft or **Submucous (covert) cleft**.
- **Structural Defects:**
- **Bifid Uvula:**
- **Neuromuscular Disorders:**
  - Impaired palatal mobility (e.g., Cerebral Palsy)

Examination

- Bifid Uvula
- V-shaped notch
- Median raphe thinning
- Testing for Hypernasality

Key Risk:
Removing adenoids in these patients can cause or worsen **Hypernasality**, as the adenoid pad often acts as a "plug" to facilitate closure.



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Published Online: July 2018
2018;144;(7):594-603. doi:10.1001/jamao-to.2018.0614

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Retrospective Danish National Cohort Study

Design	Retrospective Danish national cohort study
Population	1,189,061 children born 1979–1999 in Denmark
Follow-up	To 2009 (up to 30 years per child)
Exposure	Adenoidectomy, tonsillectomy, or adenotonsillectomy before age 9
Controls	Propensity-matched children with no surgery
Outcomes	First diagnosis of 28 disease categories after age 5
Analysis	Cox proportional hazard regression; adjusted for sex, birth year, parental SES & disease history

Method

1,189,061 singletons born between1979-1999 in Denmark

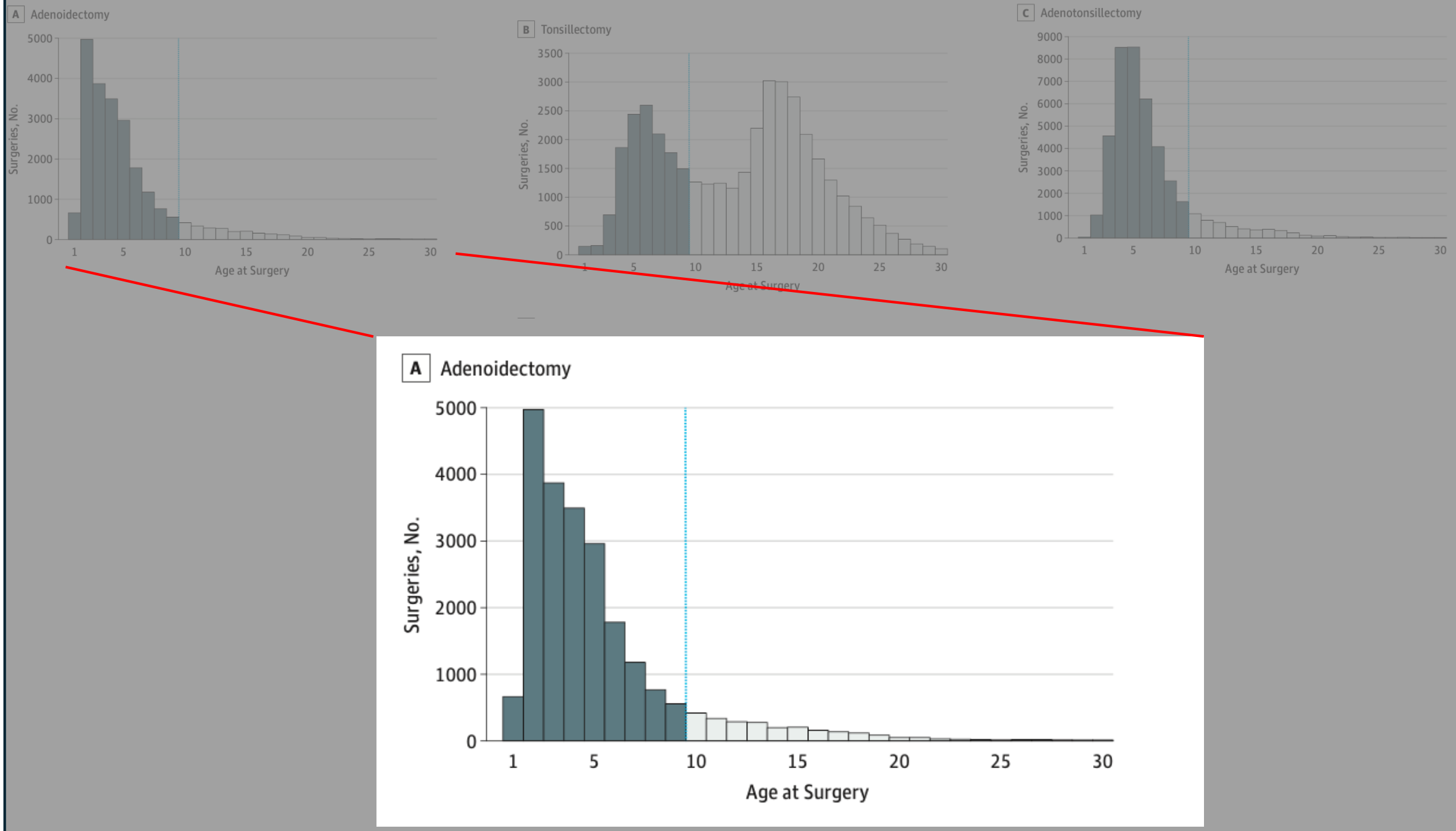
To avoid reversal causality, study only include those without outcome disease before age 9

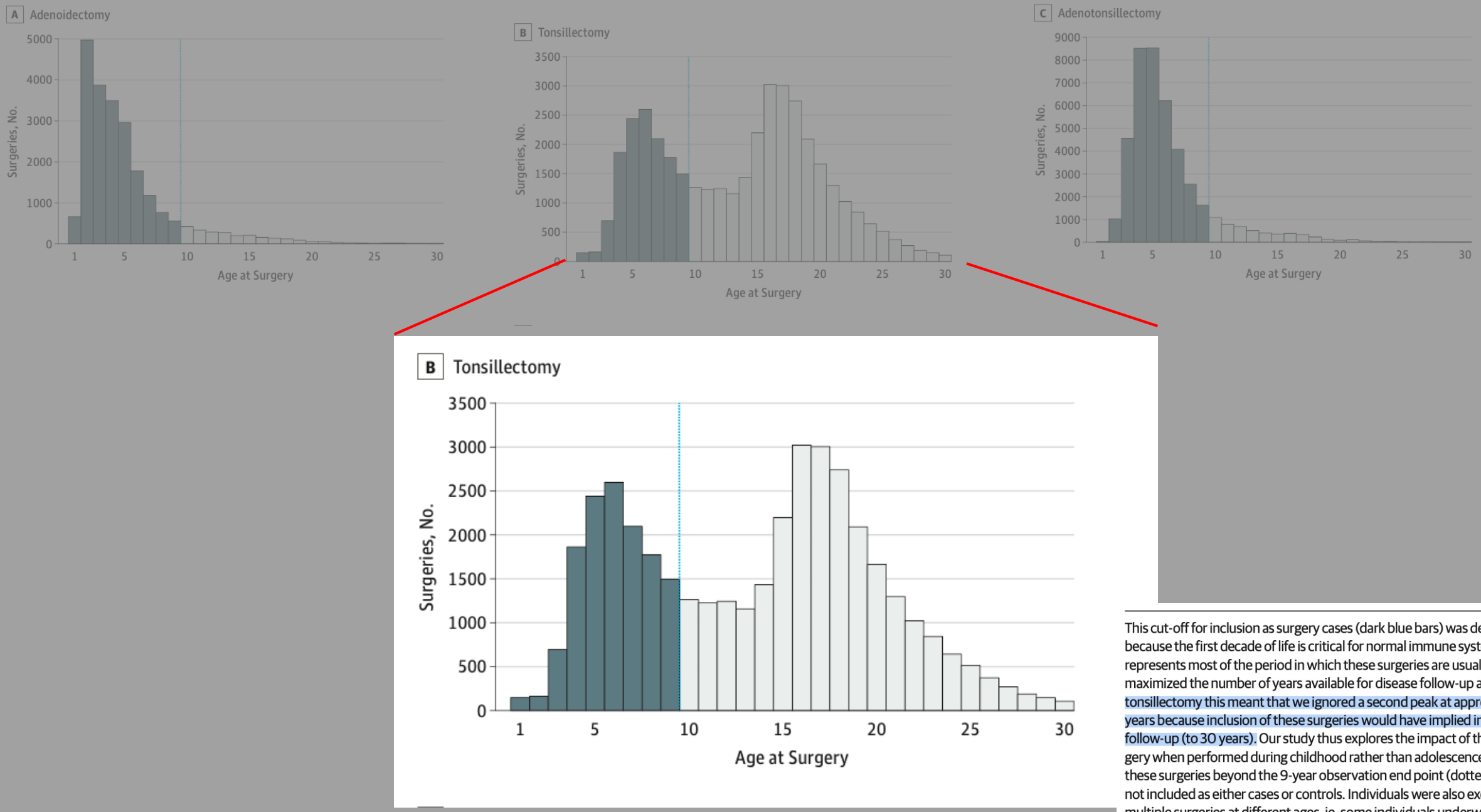
Controls (No surgery):
n = 1,157,684

Exposure Groups

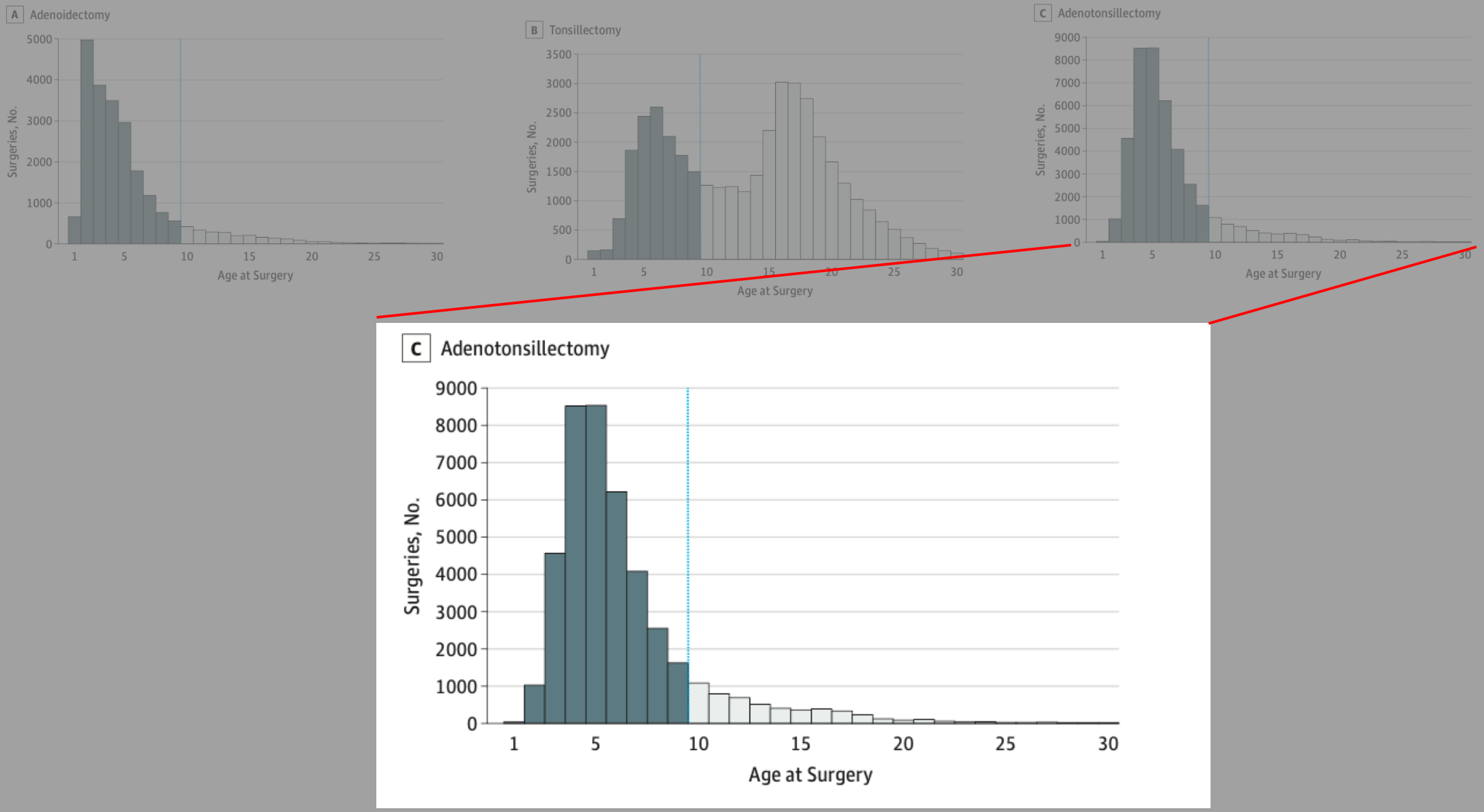
(Surgery at < 9 years old):

- **Adenoidectomy (AD): n = 17,460**
- **Tonsillectomy (TE): n = 11,830**
- **Adenotonsillectomy (ATE): n = 31,377**


A Adenoidectomy
Surgeries, No.
Age at Surgery
B Tonsillectomy
Surgeries, No.
Age at Surgery
C Adenotonsillectomy
Surgeries, No.
Age at Surgery
A Adenoidectomy
Surgeries, No.
0
1000
2000
3000
4000
5000
1
5
10
15
20
25
30
Age at Surgery



This cut-off for inclusion as surgery cases (dark blue bars) was deemed optimal because the first decade of life is critical for normal immune system development, it represents most of the period in which these surgeries are usually performed, and maximized the number of years available for disease follow-up after surgery. For tonsillectomy this meant that we ignored a second peak at approximately 16 to 17 years because inclusion of these surgeries would have implied insufficient time for follow-up (to 30 years). Our study thus explores the impact of the 3 types of surgery when performed during childhood rather than adolescence. Individuals with these surgeries beyond the 9-year observation end point (dotted vertical line) were not included as either cases or controls. Individuals were also excluded if they had multiple surgeries at different ages, ie, some individuals underwent adenoidectomy followed by tonsillectomy years later or vice versa. Such cases were rare in the sample (<0.2%).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Surgeries, No.
Age at Surgery
C Adenotonsillectomy
Surgeries, No.
Age at Surgery

Method- Analysis and confounding control

- **Health Matching:** Patients diagnosed with outcome diseases *prior* to surgery were excluded to ensure equal baseline health.
- **Statistical Model:** Stratified Cox proportional hazard regressions
- Adjusted Covariates (18 variables):
  - *Parental:* Disease history, education, income
  - *Pregnancy:* Gestation length, bleeding, hypoxia
  - *Child:* Birth weight, Apgar score, sex, parity, region
- **Metrics:** Relative Risk (RR), Absolute Risk Difference (ARD), and Number Needed to Treat/Harm (NNT/NNH). Used Bonferroni correction ($p < 0.000641$).

Table. Characteristics of the Initial Study Sample (N = 1 753 100) for Surgery and Control Groups[a]

Characteristic	No. (SD)				
	Adenoidectomy	Tonsillectomy	Adenotonsillectomy	Control	Total
Sample size, No. (%)	22 637 (1.3)	39 685 (2.3)	42 384 (2.4)	1 648 394 (94.0)	1 753 100
Paternal age mean (SD), y	30.1 (5.8)	29.7 (5.6)	30.1 (5.7)	31.3 (5.7)	31.2 (5.7)
Maternal age mean (SD), y	27.0 (4.9)	26.8 (4.7)	27.2 (4.8)	28.5 (4.8)	28.4 (4.9)
Gestation length, mean (SD), weeks	39.4 (1.9)	39.7 (1.6)	39.6 (1.7)	39.7 (1.6)	40.0 (1.6)
Maternal bleeding, % (SD)	9.6 (0.3)	8.1 (0.2)	9.0 (0.2)	7.3 (0.2)	7.4 (0.2)
Fetal oxygen deprivation, % (SD)	0.13 (0.04)	0.13 (0.04)	0.09 (0.03)	0.09 (0.03)	0.09 (0.03)
Pregnancy edema, % (SD)	1.44 (0.12)	1.42 (0.12)	1.08 (0.10)	0.79 (0.09)	0.82 (0.09)
Apgar score 1-10, mean (SD)	9.8 (0.7)	9.8 (0.5)	9.8 (0.6)	9.8 (0.6)	9.8 (0.6)
Birth weight, mean (SD), grams	3377 (597)	3443 (537)	3448 (574)	3499 (541)	3495 (543)
Preexisting hypertension (%)	0.26 (0.05)	0.15 (0.04)	0.27 (0.05)	0.33 (0.06)	0.32 (0.06)
Preexisting diabetes, % (SD)	0.40 (0.06)	0.35 (0.06)	0.50 (0.07)	0.39 (0.06)	0.39 (0.06)
Previous induced abortion (%)	20.2 (0.4)	19.5 (0.4)	19.6 (0.4)	18.2 (0.3)	18.3 (0.3)
Previous spontaneous abortion, % (SD)	16.3 (0.3)	15.5 (0.3)	15.6 (0.3)	14.2 (0.3)	14.3 (0.3)
Education, combined total years, mean (SD)	24.4 (4.9)	24.5 (4.6)	24.4 (4.6)	25.6 (4.7)	25.5 (4.8)
Income, combined average, mean (SD), DKK	381 030 (188 098)	394 585 (163 759)	361 933 (145 965)	362 241 (172 797)	363 188 (172 296)
Nationality (other than Danish) % (SD)	5.58 (0.23)	4.33 (0.2)	7.69 (0.27)	6.89 (0.25)	6.83 (0.25)
Region in Denmark most lived in, % (SD)					
Hovedstaden	29.1 (0.4)	27.4 (0.4)	23.6 (0.4)	28.7 (0.4)	28.5 (0.4)
Sjælland	21.8 (0.4)	18.6 (0.3)	16.2 (0.3)	14.5 (0.3)	14.7 (0.3)
Syddanmark	23.1 (0.4)	19.7 (0.4)	22.1 (0.4)	22.4 (0.4)	22.3 (0.4)
Midtjylland	15.0 (0.3)	23.3 (0.4)	24.9 (0.4)	23.7 (0.4)	23.6 (0.4)
Nordjylland	10.8 (0.3)	10.7 (0.3)	13.0 (0.3)	10.5 (0.3)	10.6 (0.3)
Birth year, mean (SD)	1988 (8)	1987 (6)	1991 (7)	1994 (8)	1993 (8)
Birth season, month 1-12, mean (SD)	6.4 (3.3)	6.3 (3.3)	6.4 (3.3)	6.4 (3.3)	6.4 (3.3)
Female sex, % (SD)	40.7 (0.4)	58.9 (0.4)	44.5 (0.5)	48.6 (0.5)	48.7 (0.5)
Demographic parity, % (SD)					
First born	46.2 (0.5)	45.5 (0.5)	47.9 (0.5)	44.1 (0.5)	44.3 (0.5)
Second born	37.2 (0.4)	38.2 (0.4)	35.1 (0.4)	37.3 (0.4)	37.3 (0.4)
Third born	12.0 (0.3)	12.3 (0.3)	12.6 (0.3)	13.8 (0.3)	13.7 (0.3)
Fourth (or higher born)	4.33 (0.20)	3.84 (0.19)	4.33 (0.20)	4.7 (0.21)	4.67 (0.21)

[a] Numbers, means, percentages, and SDs are provided. This is the study sample before outlying values and exclusions were applied; for exact sample sizes used in Cox regression analyses for each disease group, see eTable 1 in the Supplement.

No Parental Smoking Date

Parental Factors

Perinatal Factors

Demographics

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Sample size, No. (%)	22 637 (1.3)	39 685 (2.3)	42 384 (2.4)	1 648 394 (94.0)	1 753 100
Paternal age mean (SD), y	30.1 (5.8)	29.7 (5.6)	30.1 (5.7)	31.3 (5.7)	31.2 (5.7)
Maternal age mean (SD), y	27.0 (4.9)	26.8 (4.7)	27.2 (4.8)	28.5 (4.8)	28.4 (4.9)
Gestation length, mean (SD), weeks	39.4 (1.9)	39.7 (1.6)	39.6 (1.7)	39.7 (1.6)	40.0 (1.6)
Maternal bleeding, % (SD)	9.6 (0.3)	8.1 (0.2)	9.0 (0.2)	7.3 (0.2)	7.4 (0.2)
Fetal oxygen deprivation, % (SD)	0.13 (0.04)	0.13 (0.04)	0.09 (0.03)	0.09 (0.03)	0.09 (0.03)
Pregnancy edema, % (SD)	1.44 (0.12)	1.42 (0.12)	1.08 (0.10)	0.79 (0.09)	0.82 (0.09)
Apgar score 1-10, mean (SD)	9.8 (0.7)	9.8 (0.5)	9.8 (0.6)	9.8 (0.6)	9.8 (0.6)
Birth weight, mean (SD), grams	3377 (597)	3443 (537)	3448 (574)	3499 (541)	3495 (543)
Preexisting hypertension (%)	0.26 (0.05)	0.15 (0.04)	0.27 (0.05)	0.33 (0.06)	0.32 (0.06)
Preexisting diabetes, % (SD)	0.40 (0.06)	0.35 (0.06)	0.50 (0.07)	0.39 (0.06)	0.39 (0.06)
Previous induced abortion (%)	20.2 (0.4)	19.5 (0.4)	19.6 (0.4)	18.2 (0.3)	18.3 (0.3)
Previous spontaneous abortion, % (SD)	16.3 (0.3)	15.5 (0.3)	15.6 (0.3)	14.2 (0.3)	14.3 (0.3)
Education, combined total years, mean (SD)	24.4 (4.9)	24.5 (4.6)	24.4 (4.6)	25.6 (4.7)	25.5 (4.8)
Income, combined average, mean (SD), DKK	381 030 (188 098)	394 585 (163 759)	361 933 (145 965)	362 241 (172 797)	363 188 (172 296)
Nationality (other than Danish) % (SD)	5.58 (0.23)	4.33 (0.2)	7.69 (0.27)	6.89 (0.25)	6.83 (0.25)
Region in Denmark most lived in, % (SD)					
Hovedstaden	29.1 (0.4)	27.4 (0.4)	23.6 (0.4)	28.7 (0.4)	28.5 (0.4)
Sjælland	21.8 (0.4)	18.6 (0.3)	16.2 (0.3)	14.5 (0.3)	14.7 (0.3)
Syddanmark	23.1 (0.4)	19.7 (0.4)	22.1 (0.4)	22.4 (0.4)	22.3 (0.4)
Midtjylland	15.0 (0.3)	23.3 (0.4)	24.9 (0.4)	23.7 (0.4)	23.6 (0.4)
Nordjylland	10.8 (0.3)	10.7 (0.3)	13.0 (0.3)	10.5 (0.3)	10.6 (0.3)
Birth year, mean (SD)	1988 (8)	1987 (6)	1991 (7)	1994 (8)	1993 (8)
Birth season, month 1-12, mean (SD)	6.4 (3.3)	6.3 (3.3)	6.4 (3.3)	6.4 (3.3)	6.4 (3.3)
Female sex, % (SD)	40.7 (0.4)	58.9 (0.4)	44.5 (0.5)	48.6 (0.5)	48.7 (0.5)
Demographic parity, % (SD)					
First born	46.2 (0.5)	45.5 (0.5)	47.9 (0.5)	44.1 (0.5)	44.3 (0.5)
Second born	37.2 (0.4)	38.2 (0.4)	35.1 (0.4)	37.3 (0.4)	37.3 (0.4)
Third born	12.0 (0.3)	12.3 (0.3)	12.6 (0.3)	13.8 (0.3)	13.7 (0.3)
Fourth (or higher born)	4.33 (0.20)	3.84 (0.19)	4.33 (0.20)	4.7 (0.21)	4.67 (0.21)

[a] Numbers, means, percentages, and SDs are provided. This is the study sample before outlying values and exclusions were applied; for exact sample sizes used in Cox regression analyses for each disease group, see eTable 1 in the Supplement.

No Parental Smoking Date

Parental Factors

Perinatal Factors

Demographics

JAMA Otolaryngology–
Head & Neck Surgery

Result

Original Investigation FREE

Cite Permissions Metrics

Association of Long-Term Risk of Respiratory, Allergic, and Infectious Diseases With Removal of Adenoids and Tonsils in Childhood

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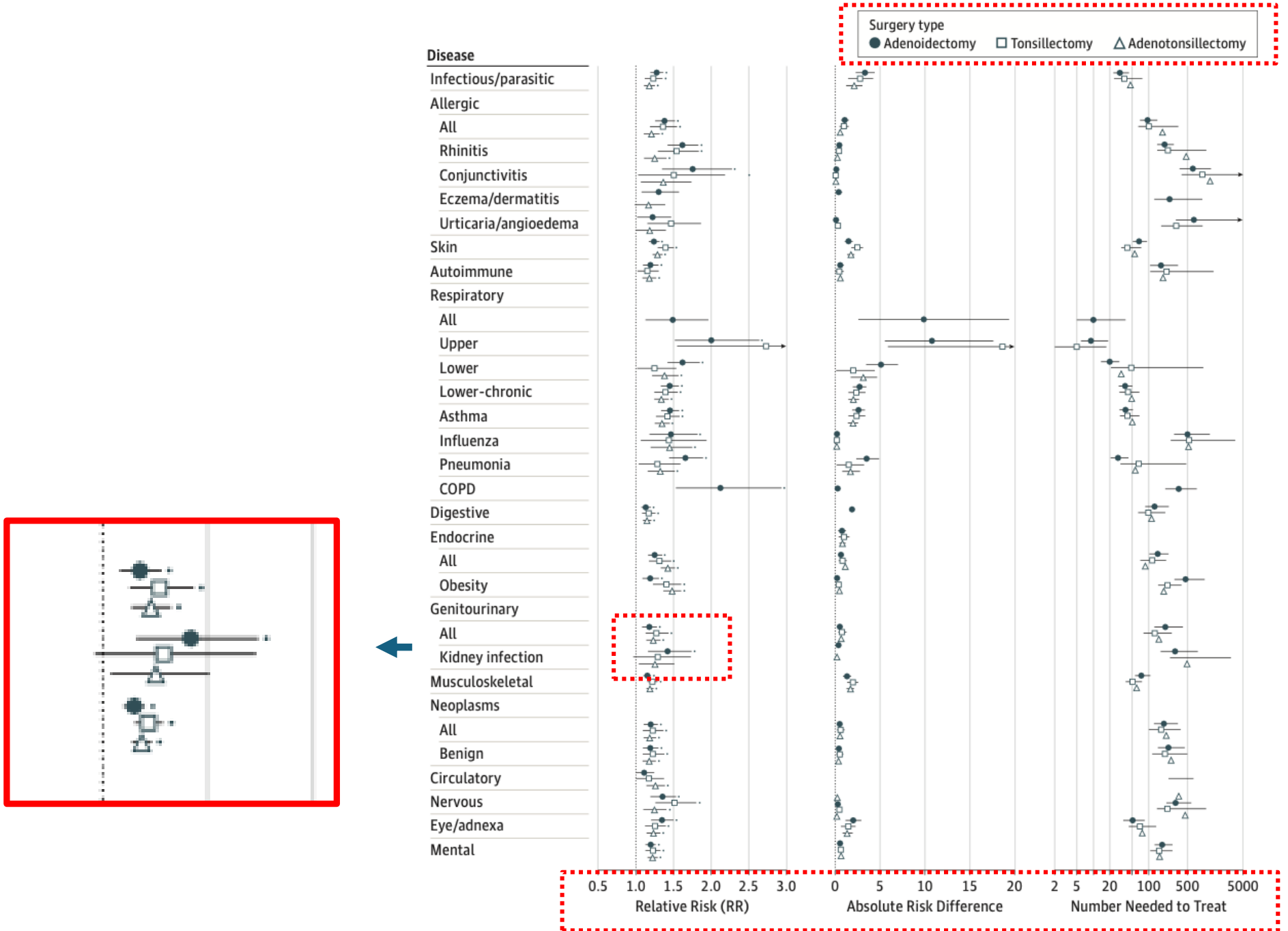
Author Affiliations | Article Information

JAMA Otolaryngol Head Neck Surg
Published Online: July 2018
2018;144(7):594-603. doi:10.1001/jamaoto.2018.0614

Figure 2. Risk of Disease Up to Age 30 Years After Removal of Tonsils and Adenoids in the First 9 Years of Life



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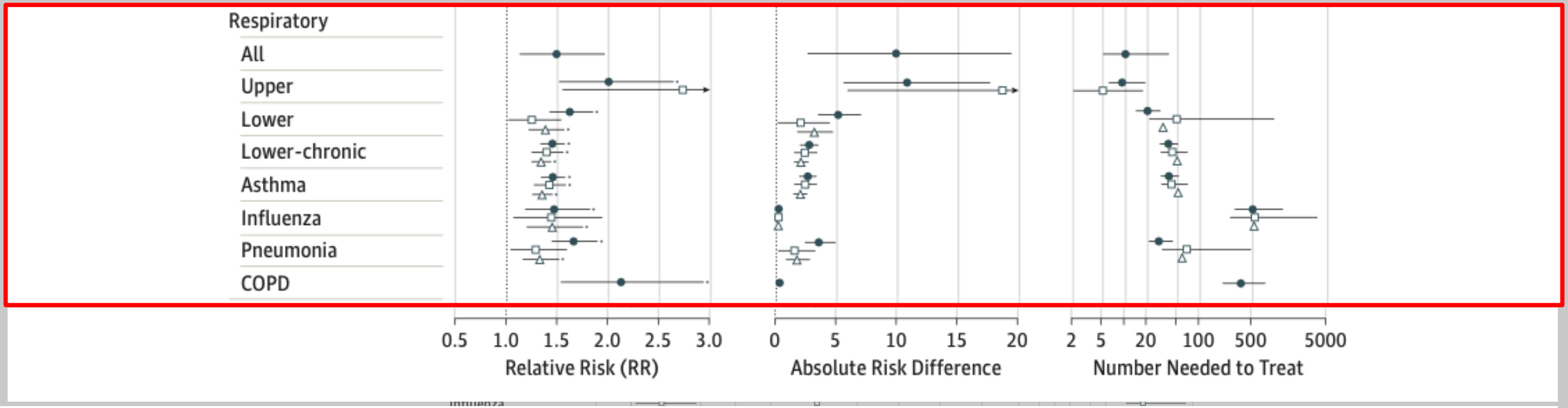

手術類型	Disease/Condition	RR (95% CI)	ARD (95% CI)	NNT / NNH
Tonsillectomy	Upper respiratory tract diseases	2.72 (1.54-4.80)	18.61%	5 (NNH)
Adenoidectomy	COPD	2.11 (1.53-2.92)	0.29% (0.13-0.48)	349 (NNH)
	Upper respiratory tract diseases	1.99 (1.51-2.63)	10.7% (5.49-17.56)	9 (NNH)
	Conjunctivitis	1.75 (1.35-2.26)	0.16% (0.07-0.26)	624 (NNH)
	Asthma	1.45 (1.33-1.57)	2.60%	38 (NNH)
	Sleep disorders**	0.30 (0.15-0.60)	-0.083% (-0.10 to -0.05)	-
Adenotonsillectomy	Infectious diseases	1.17 (1.10-1.25)	2.14%	47 (NNH)
	Sinusitis	1.68 (1.32-2.14)	0.11% (0.05-0.19)	-
Any surgeries	Otitis media	2.06-4.84 (範圍)	5.3% - 19.4% (範圍)	-
	Tonsillitis and chronic tonsillitis	0.09-0.54 (範圍)	-0.29% to -2.10% (範圍)	-

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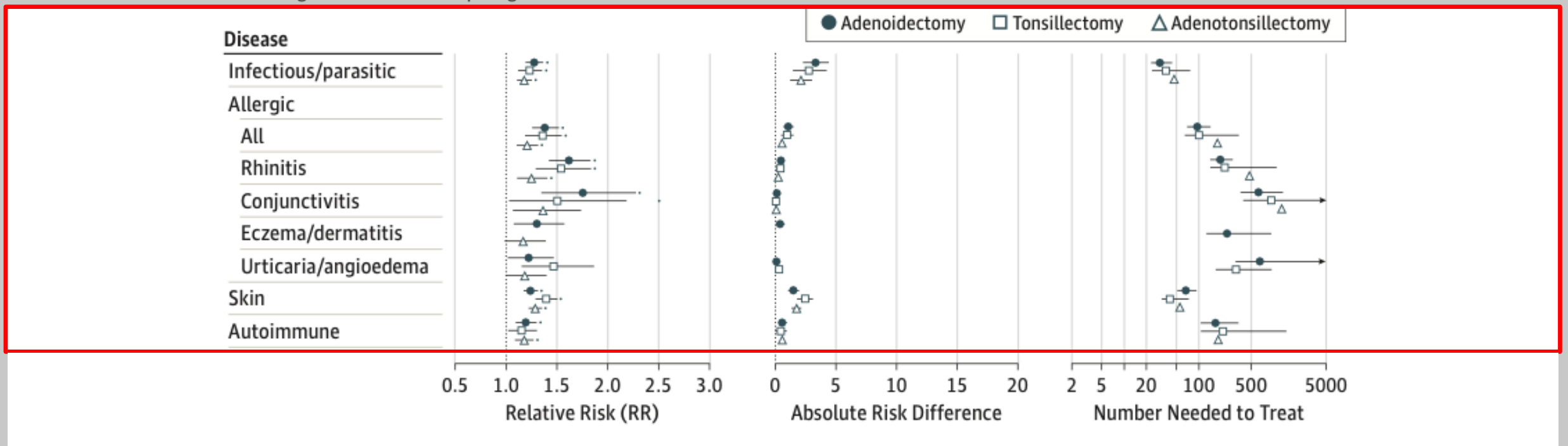

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Surgical Indications ?

Table S8. Relative risks (RR), absolute risk difference (ARD), number needed to treat (NNT(B/H) or benefit/harm) for conditions surgeries aim to treat

	adenoidectomy				tonsillectomy				adenotonsillectomy				
Conditions	**RR**	**ER**	**ARD**	**NNT(B/H)**	**RR**	**ER**	**ARD**	**NNT(B/H)**	**RR**	**ER**	**ARD**	**NNT(B/H)**	**CR**
Sleep disorders	0.30(0.15-0.60)*	1.05	-0.083 %	-1209 (B)	0.24(0.07-0.75)	-	-	-	0.46(0.28-0.77)	-	-	-	0.119
Abnormal breathing	1.04(0.61-1.78)	-	-	-	0.70(0.26-1.89)	-	-	-	0.59(0.30-1.14)	-	-	-	0.045
Sinusitis	1.54(1.14-2.08)	-	-	-	1.03(0.63-1.69)	-	-	-	1.68(1.32-2.14)***	0.479	+0.116%	865 (H)	0.169
Chronic sinusitis	2.25(1.69-3.00)***	1.47	+0.11%	905 (H)	1.25(0.75-2.08)	-	-	-	1.17(0.84-1.63)	-	-	-	0.088
Otitis media	4.84(4.48-5.23)***	57.75	+19.495%	5 (H)	2.22(1.94-2.54)***	10.263	+6.217%	16 (H)	2.06(1.88-2.25)***	27.513	+5.385%	19 (H)	5.073
Tonsillitis	0.21(0.16-0.29)***	5.86	-1.815 %	-55 (B)	0.09(0.05-0.17)***	16.487	-2.102 %	-48 (B)	0.09(0.06-0.14)***	14.685	-2.092 %	-48 (B)	2.321
Chronic tonsillitis	0.54(0.39-0.74)**	92.36	-0.299 %	-334 (B)	0.20(0.11-0.38)***	80.486	-0.52 %	-192 (B)	0.11(0.06-0.19)***	98.315	-0.582 %	-172 (B)	0.657

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Key Results - Outcomes for Surgical Indications

- **Tonsillitis:** Reduced risk post-surgery.
- **Sleep disorders**: Reduced risk post-surgery.
- **Otitis Media:** 2- to 5-fold **increase** in risk post-surgery (RR = 2.06–4.84).
- **Sinusitis:** Significantly **increased** after ATE (RR = 1.68).

Figure 3. Disease Risk Patterns for Covariates

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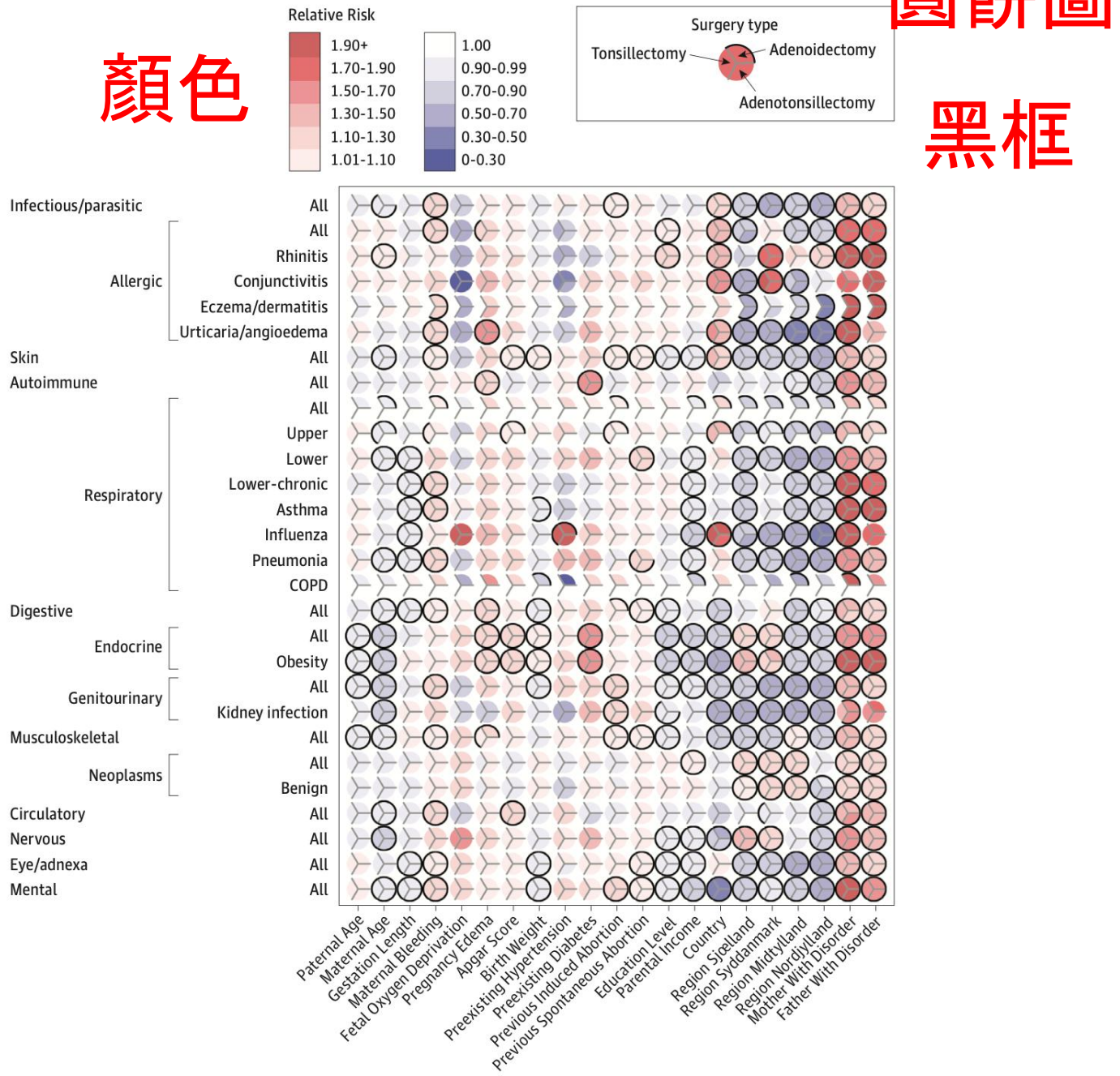

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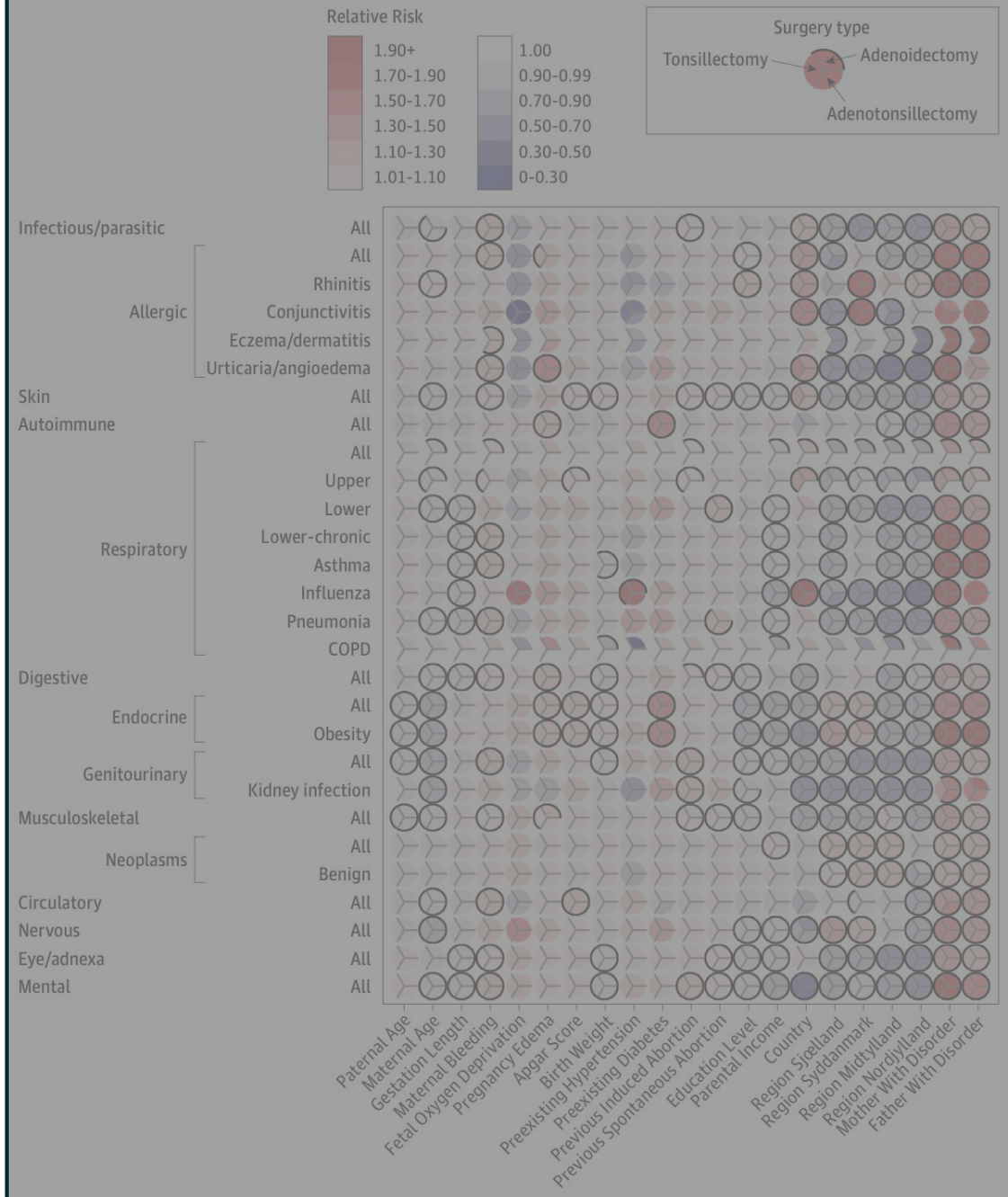

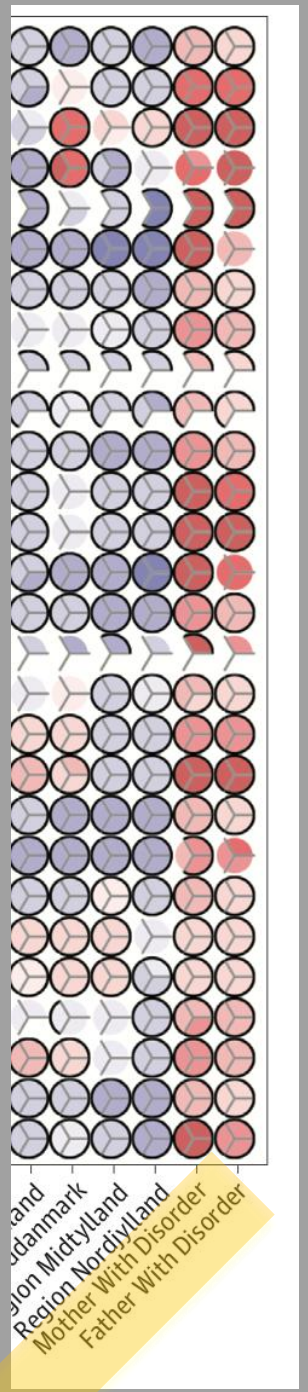

Conclusion

CONCLUSIONS AND RELEVANCE In this study of almost 1.2 million children, of whom 17 460 had adenoidectomy, 11 830 tonsillectomy, and 31 377 adenotonsillectomy, surgeries were associated with increased long-term risks of respiratory, infectious, and allergic diseases. Although rigorous controls for confounding were used where such data were available, it is possible these effects could not be fully accounted for. Our results suggest it is important to consider long-term risks when making decisions to perform tonsillectomy or adenoidectomy.

Discussion

- **Shift in Perspective:**

  Traditionally focus on short-term symptom relief. This study provides the missing piece: long-term systemic risks.

- **The Immune Cost:**

  Removal of tonsils/adenoids early in life impairs early pathogen detection.

- **Developmental Origins of Disease:**

  Early-life perturbations to the developing immune system have lifelong consequences on general health.

- **Risk-Benefit Imbalance:**

  Long-term absolute risks (e.g., respiratory infections) are considerably larger than the long-term benefits for conditions the surgeries aim to treat.

Study limitation

- **Observational Design:**

Potential for residual confounding and reverse causation despite rigorous matching.

- **Unmeasured Confounders:**

Lack of direct parental smoking data (though parental education was used as a proxy).

- **Age Limitation:**

Follow-up only up to 30 years of age.

- **Generalizability:**

Conducted in a highly homogeneous Danish population with equal access to free healthcare

Discussion

- Confounding by indication?
  - 9歲以前完全沒得過URI?


THANKS FOR
LISTENING