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LETTER TO THE EDITOR

WILEY

Early childhood allergy prevention behaviors: Trends in Germany from 2015 to 2020

To the Editor,

Early childhood allergy prevention (ECAP) behaviors encompass a wide range of parental behaviors with regard to children's exposure to or avoidance of allergens, including maternal and child nutrition or modification of the living environment. The paradigm shift in allergy prevention from avoidance to exposure has questioned many measures formerly presumed efficacious and resulted in a revised guideline on childhood allergy prevention in Germany in 2014.[1–3] This guideline specifies not only the behaviors recommended for allergy prevention (e.g., breastfeeding and early introduction of solid food), but also discourages most measures promoting avoidance of allergens. A new revision has been currently published.[4] We are not aware of studies investigating whether and to what extent families in Germany engage in ECAP behaviors and if there are secular trends. Therefore, we observed prevalences and trends in ECAP behaviors of mothers in Germany over a period of 5 years (2015 to 2020).

We used data from a prospective birth cohort in Regensburg (Germany), the KUNO Kids health study.[4] All mothers who gave consent and participated with their newborn child in the study for at least 1 year (recruited from June 2015 to March 2020, with data collection until March 2021) were included. Sociodemographic and ECAP data were collected directly after birth of the child, at the age of 4 weeks, 6 months, and 1 year, respectively, using standardized computer-assisted personal interviews (CAPI) and paper-based self-report questionnaires. The study has been approved by the Ethics Committee of the University of Regensburg (reference numbers: 14-101-0347, 19-1646-101).

Early childhood allergy prevention behaviors considered in our analyses (informed by PASTURE[5] and the recommendations of the S3-Guideline for Allergy Prevention[3]) were: fish in mothers' diet during pregnancy, during feeding with breastmilk, as part of solid food during the child's first year of life (≥1/<1 per week); smoking during pregnancy (yes/no); allergy prevention-related avoidance of specific foods in mothers' diet during feeding with breastmilk, in the child's diet during first year of life (fish, meat, dairies, wheat, hen egg, nuts (incl. peanuts), soy, citruses, other fruit or vegetable, other foods: yes (any)/no); duration of predominant breastfeeding (no breastfeeding/<4/≥4 months); regular feeding of hypoallergenic (HA) infant milk; age of introduction of solid foods (<4/4–6 />6 months); feeding of farm milk (yes (cow milk not boiled/boiled/goat milk)/no); allergy prevention-related measures for reducing house dust mites (removal of carpets, additional cleaning, use of specific vacuum cleaners, mattress encasing, allergy mattress, allergy pillow/blanket: yes (any)/no); exposure to tobacco smoke by smoking of parents or in the child's home (yes/no); removal of pets (any fury pets, cats: yes/no); avoidance of pets (yes/no); regular (≥1 per week) contact with hay (yes/no). Children whose mother, father, or sibling had an allergic disease (self-reported diagnosis of food allergy, allergic rhinitis, allergic conjunctivitis, bronchial asthma, or atopic dermatitis) were defined as at-risk for allergy.

Crude prevalence estimates and 95% confidence intervals (CIs) were calculated for ECAP behaviors, in the total sample and stratified for allergy risk status. Multivariate imputation by chained equations (MICE[6]) was applied to handle missing data. In order to analyze trends over time, two independent cross-sectional datasets were prepared by splitting the dataset into two cohorts (cohort 1: including the first 50% of newborns born 2015 to mid-2017; cohort 2: including the second 50% of newborns born mid-2017 to 2020). We tested for differences in sociodemographic variables using *t*-test and Wilcoxon rank sum test. Trend analyses for estimating change in ECAP behaviors were performed using adjusted logistic regression modeling, for the total sample and stratified for allergy risk status. Results were adjusted for multiple testing using the Hommel method.[7] All analyses were performed according to an a priori specified analysis plan,[8] using SPSS and R. *p*-values below .05 were considered statistically significant.

Baseline characteristics of $N = 1662$ mothers included in our analyses are shown in Table 1. $N = 1442$ mothers dropped out before the 1-year assessment.

Prevalences of ECAP behaviors: 23.7% (CI: 21.5–25.9) of mothers renounced specific foods in their diet (any) during feeding with breastmilk, 40.1% (CI: 37.7–42.4) in their child's diet during the first year of life. 67.9% (CI: 65.6–70.1) of mothers were predominantly breastfeeding at least 4 months and 92% (CI: 91–94) introduced solid foods between the 4th and 6th month. 43.5% (CI: 40.3–46.7) of children who were not predominantly breastfed were fed with hypoallergenic (HA) infant milk. Weekly fish consumption was 51.9% (CI: 49.5–54.3) during pregnancy, 57.7% (CI: 55.1–60.3) during feeding with breastmilk, and 64.6% (CI: 62.3–66.9) for the child during the first year of life. There was no

TABLE 1 Baseline characteristics of participating mothers

Characteristic	Total sample ($N = 1662$)		Cohort 2015–2017 ($N = 893$)		Cohort 2017–2020 ($N = 769$)		p
	N		*N*		*N*		
Age (years), *Mean* (SD)	1647	32.61 (4.1)	887	32.56 (4.1)	760	32.67 (4.1)	.58
Marital status, *N* (%)	1629		872		757		.22
Married, living together with husband		1333 (81.83%)		704 (80.73%)		629 (83.09%)	
Unmarried, living together with partner		271 (16.64%)		153 (17.55%)		118 (15.59%)	
Living without partner/ divorced/widowed		25 (1.53%)		15 (1.72%)		10 (1.32%)	
Migration background (country of birth other than Germany), *N* (%)	1631	149 (9.14%)	874	88 (10.07%)	757	61 (8.06%)	.17
Education, *N* (%)	1626		871		755		.61
No degree or less than 10 years of schooling		107 (6.58%)		64 (7.35%)		43 (5.70%)	
10 years of schooling		494 (30.38%)		249 (28.59%)		245 (32.45%)	
University entrance level		1025 (63.04%)		558 (64.06%)		467 (61.85%)	
Employment before birth, *N* (%)	1627	1481 (91.03%)	871	802 (92.08%)	756	679 (89.81%)	.10
Primiparous, *N* (%)	1644	1048 (63.75%)	882	536 (60.77%)	762	512 (67.19%)	**.02***

**t*-Test and Wilcoxon rank sum test (W) were used for comparing participant characteristics between the two cohorts. *p*-values below .05 were considered statistically significant. $W = 362{,}923$ ($p = .02$) for parity.

smoking in the home of 90% (CI: 88.5–91.4) of children; 1.4% (CI: 0.9–2) of mothers smoked during pregnancy. 16.7% (CI: 14.9–18.5) of families took any measure against dust mites, 2.1% (CI: 1.5–2.8) deliberately kept their children away from pets. 6.4% (CI: 5.3–7.6) of children had regular contact with hay, 12.3% (CI: 10.7–13.9) received cow/goat milk directly from the farm. 57.6% (CI: 55.3–60) of the children were at-risk for allergy. Prevalences for both cohorts as well as stratified for children at-risk and not at-risk for allergies are presented in Figure 1.

Trends of ECAP behaviors: Baseline characteristics of cohort 1 (2015–2017, $N = 893$) and cohort 2 (2017–2020; $N = 769$) differed only regarding parity (see Table 1). Accordingly, trend analyses were adjusted for parity. There was no statistically significant upward or downward trend from 2015–2017 to 2017–2020 in any ECAP behavior, neither in the total sample nor in the stratified samples (see Table S2).

This study yields findings with relevance for child health and allergy prevention as more than half of the children were at-risk for allergy. We found that some recommended ECAP behaviors were practiced in most families, in particular the early introduction of solids. However, allergen avoidance measures were also implemented—in both children at-risk and not at-risk for allergies. Remarkably, the prevalences of specific ECAP behaviors practiced in families did not change significantly from 2015–2017 to 2017–2020. Based on the time period studied, the paradigm shift in allergy prevention may not have (yet) reached young families in Germany. There is recent data from the United States indicating that the dissemination and implementation of guideline recommendations occurred at least to some extent within 5 years.[9] We assumed the paradigm shift to be a continuous process with a probably slow change in the direction of the recommendations, but the time period covered by our study might have been too short for substantial changes to occur. An increase in adherence to recommended guideline behaviors following guideline revision was shown in Australia—but the study covered a decade and compared data from 2007 to 2011 with data from 2017 to 2019.[1,10] When the earliest cases in our samples were contrasted with the latest cases (data not shown), tendencies for behavior change over time could be seen at least in a few ECAP behaviors. This encourages further long-term research, especially since further changes can be expected with the recent publication of the new 2022 guideline on allergy prevention in Germany.[4] In addition to the restricted time frame we could cover in this study another limitation of the study relates to selection bias. Our sample was characterized by a high proportion of highly educated women without migration background from an affluent area that limits the generalizability of our findings. Lastly, the study relied on self-report measurement instruments that limit the validity of the findings. We cannot exclude bias due to memory effects or social desirability. We conclude that further research over a longer time period is warranted in order to investigate the implementation of allergy prevention behaviors in Germany. Providing easy access to evidence-based allergy prevention information for families with and without risk of allergy might be helpful. Pediatricians, gynecologists, and midwives could play a crucial role in communicating recommendations for allergy prevention to families.[11]

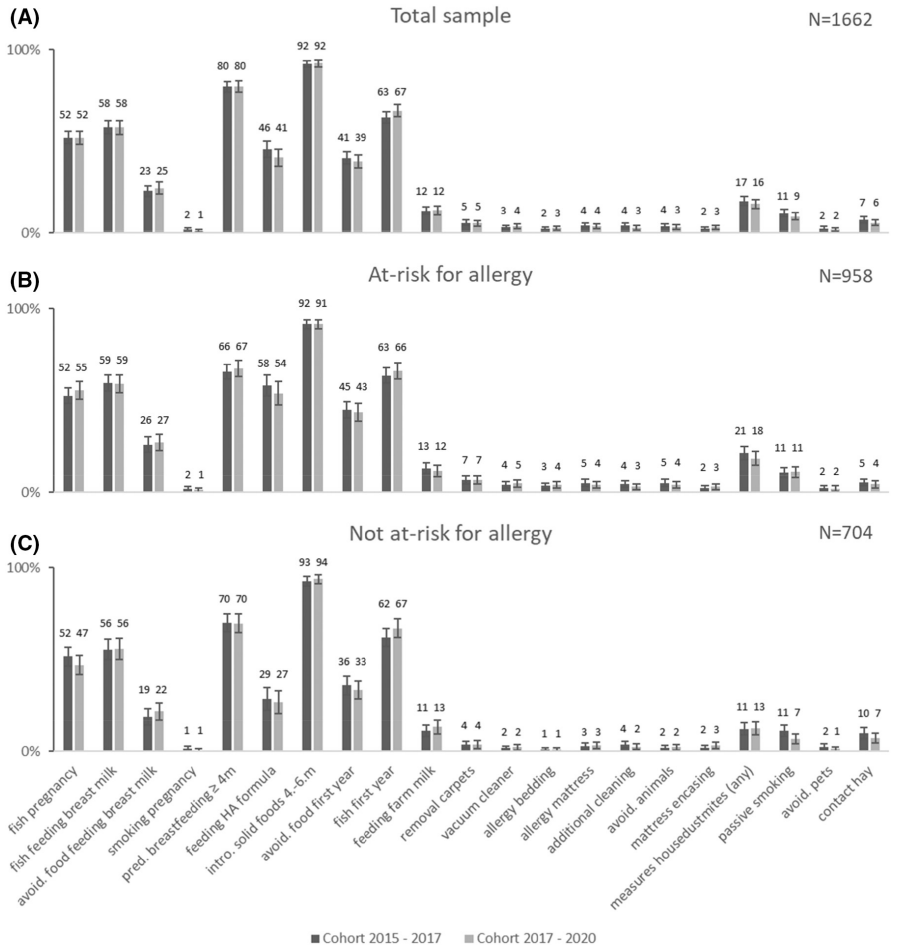

FIGURE 1 ECAP prevalences (%) and 95% CIs in both cohorts (2015–2017, 2017–2020) for the total sample (A), children at-risk (B) and not at-risk (C) for allergies.

AUTHOR CONTRIBUTIONS

Maja Pawellek: Conceptualization; investigation; writing – original draft; methodology; visualization; writing – review and editing; formal analysis; project administration; data curation. **Angela Köninger:** Writing – review and editing; data curation; resources. **Michael Melter:** Writing – review and editing; data curation; resources. **Michael Kabesch:** Writing – review and editing; data curation; resources. **Christian Apfelbacher:** Funding acquisition; methodology; writing – review and editing; data curation. **Susanne Brandstetter:** Conceptualization; investigation; funding acquisition; writing – original draft; methodology; writing – review and editing; project administration; data curation; supervision.

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Andreas Ambrosch (Institute of Laboratory Medicine, Microbiology and Hygiene, Barmherzige Brüder Hospital, Regensburg, Germany), Petra A. Arndt (ZNL Transfercenter of Neuroscience and Learning, University of Ulm, Ulm, Germany), Andrea Baessler (Department of Internal Medicine II, Regensburg University Medical Center, Regensburg, Germany), Mark Berneburg (Department of Dermatology, University Medical Centre Regensburg, Regensburg, Germany), Stephan Böse-O'Reilly (University Children's Hospital Regensburg (KUNO), Hospital St. Hedwig of the Order of St. John, Regensburg, Germany), Romuald Brunner (Clinic of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, Bezirksklinikum Regensburg (medbo), Regensburg, Germany), Sara Fill Malfertheiner (Clinic of Obstetrics and Gynecology St. Hedwig, University of Regensburg, Regensburg, Germany), André Franke (Institute of Clinical Molecular Biology, Christian-Albrechts-University of Kiel, Kiel, Germany), Sebastian Häusler (Clinic of Obstetrics and Gynecology St. Hedwig, University of Regensburg, Regensburg, Germany), Iris Heid (Department of Genetic Epidemiology, University of Regensburg, Regensburg, Germany), Stefanie Heinze (Bavarian Health and Food Safety Authority (LGL) Munich, Germany), Wolfgang Högler (Department of Pediatrics and Adolescent Medicine, Johannes Kepler University Linz, Linz, Austria), Sebastian Kerzel (Department of Pediatric Pneumology and Allergy, University Children's Hospital Regensburg (KUNO), Hospital St. Hedwig of the Order of St. John, Regensburg, Germany), Michael Koller (Center for Clinical Studies, University Hospital Regensburg, Regensburg, Germany), Michael Leitzmann (Department of Epidemiology and Preventive Medicine, University of Regensburg, Regensburg, Germany), Áine Lennon (Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, University of Regensburg, Regensburg, Germany), David Rothfuß

(City of Regensburg, Coordinating Center for Early Interventions, Regensburg, Germany), Wolfgang Rösch (Department of Pediatric Urology, University Medical Center, Regensburg, Germany), Bianca Schaub (Pediatric Allergology, Department of Pediatrics, Dr. von Hauner Children's Hospital, University Hospital, LMU Munich, Munich, Germany), Stephan Weidinger (Department of Dermatology, Venereology and Allergy, University Hospital Schleswig-Holstein, Campus Kiel, Kiel, Germany), and Sven Wellmann (Department of Neonatology, University Children's Hospital Regensburg (KUNO), Hospital St. Hedwig of the Order of St. John, Regensburg, Germany).

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CONFLICT OF INTEREST STATEMENT

The authors report no conflict of interest.

PEER REVIEW

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Maja Pawellek[1,2]
Angela Köninger[2,3]
Michael Melter[1,2]
Michael Kabesch[1,2]
Christian Apfelbacher[2,4]
Susanne Brandstetter[1,2]
KUNO-Kids study group

[1]*University Children's Hospital Regensburg (KUNO), Regensburg, Germany*
[2]*Member of the Research and Development Campus Regensburg (WECARE), Hospital St. Hedwig of the Order of St. John, Regensburg, Germany*
[3]*University Department of Gynecology and Obstetrics, Hospital St. Hedwig of the Order of St. John, University Medical Center Regensburg, Regensburg, Germany*
[4]*Institute of Social Medicine and Health Systems Research, Otto von Guericke University Magdeburg, Magdeburg, Germany*

Correspondence
Maja Pawellek, University Children's Hospital Regensburg (KUNO), Regensburg, Germany.
Email: maja.pawellek@klinik.uni-regensburg.de

Editor: Jon Genuneit

ORCID

Maja Pawellek https://orcid.org/0000-0002-8551-4427
Michael Melter https://orcid.org/0000-0002-4194-0758
Michael Kabesch https://orcid.org/0000-0003-0697-1871
Christian Apfelbacher https://orcid.org/0000-0003-3805-8219
Susanne Brandstetter https://orcid.org/0000-0002-7021-8895

REFERENCES

1. McWilliam V, Venter C, Greenhawt M, et al. A pragmatic approach to infant feeding for food allergy prevention. *Pediatr Allergy and Immunol*. 2022;33(9):e13849.
2. Sampath V, Abrams EM, Adlou B, et al. Food allergy across the globe. *J Allergy Clin Immunol*. 2021;148(6):1347-1364.
3. Schäfer T, Bauer C-P, Beyer K, et al. S3-guideline on allergy prevention: 2014 update: guideline of the German Society for Allergology and Clinical Immunology (DGAKI) and the German Society for Pediatric and Adolescent Medicine (DGKJ). *Allergo J Int*. 2014;23(6):186-199.
4. Kopp MV, Muche-Borowski C, Abou-Dakn M, et al. S3 guideline allergy prevention. *Allergol Select*. 2022;6:61-97.
5. von Mutius E, Schmid S. The PASTURE project: EU support for the improvement of knowledge about risk factors and preventive factors for atopy in Europe. *Allergy*. 2006;61(4):407-413. https://pubmed.ncbi.nlm.nih.gov/16512801/
6. Buuren S, Groothuis-Oudshoorn C. MICE: multivariate imputation by chained equations in R. *J Stat Softw*. 2011;45(3). http://www.jstatsoft.org/v45/i03
7. Vickerstaff V, Omar RZ, Ambler G. Methods to adjust for multiple comparisons in the analysis and sample size calculation of randomised controlled trials with multiple primary outcomes. *BMC Med Res Methodol*. 2019;19(1):129.
8. Pawellek M, Brandstetter S. Prevalences and trends in early childhood allergy prevention behaviours in Germany between 2015 and 2020. 2022. Accessed November 14, 2022. https://doi.org/10.17605/OSF.IO/RDXWV
9. Venter C, Warren C, Samady W, et al. Food allergen introduction patterns in the first year of life: a US nationwide survey. *Pediatr Allergy Immunol*. 2022;33(12):e13896.
10. Koplin J, Soriano V, Netting M, Peters R. Infant feeding patterns before and after changes to food allergy prevention guidelines in Australia. *Med J Aust*. 2022;217(4):210-211.
11. von Sommoggy J, Grepmeier E-M, Curbach J. Health literacy-sensitive counselling on early childhood allergy prevention: results of a qualitative study on German Midwives' perspectives. *Int J Environ Res Public Health*. 2022;19(7):4182.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.