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Racial Differences in Timing of Food Allergen Introduction

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Food allergy (FA) impacts 8% of children in the United States (US),[1] with disease prevalence varying by race and highest rates observed among Black children.[2,3] However, it is unclear what factors may underlie racial differences in prevalence. Racial differences in timing of food allergen introduction during infancy may influence FA development and disease manifestation. The NIAID released the Addendum Guidelines for the Prevention of Peanut Allergy in the US in 2017 (PPA guidelines). The PPA guidelines encourage peanut allergy risk assessment for infants and introduction of peanut products into an infant's diet around 4-6 months of age for those at high risk.[4]

In the Enquiring About Tolerance (EAT) study, non-White participants had higher rates of FA and were less likely to adhere to the early introduction feeding protocol.[5] Racial differences in the timing of food allergen introduction among infants have yet to be extensively studied in the US. Therefore, this study aims to identify potential racial differences in parent/caregiver-reported timing of infant introduction to peanut, milk, and egg products among children with allergies to these foods.

Black and White children ≤12 years old with allergist-diagnosed IgE-mediated FA(s) were enrolled in the multi-site, Food Allergy Outcomes Related to White and African American Racial Differences (FORWARD) cohort, whose study design has been previously published.[6] This study is a cross-sectional analysis of parent/caregiver-reported study baseline data at least 3 years after the participant's first year of life. Sample sociodemographic characteristics are reported in Table 1 and compared across racial groups. Among children whose parent/caregiver reported feeding specific food allergens,

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chi-squared tests assessed associations by race concerning the age (≤ 6 months, 7-11 months, >11 months) at which children with specific FAs (i.e., peanut, egg, and/or milk -including cow's milk formula) were first introduced to that specific food. Multiple logistic regression analyses presented in Table E1 assessed determinants of earlier or later allergen introduction, including adjustment for child age, race (Black vs White), eczema status (yes vs no), number of parent/caregiver-reported food allergies (multiple vs single), gender (female vs male), and study recruitment site.

Overall, 632 children with FA (234 Black and 398 White; mean [SD] age=6.0[3.7]) were included in the analyses (Table 1). Peanut allergy was the most common food allergen among participants (65.3%) with similar prevalence by race (Black: 65.4% vs White: 65.3%, p>0.99). Reported peanut, milk, and egg introduction were delayed among Black children compared to their White counterparts. (Table 2).

After adjusting for participant demographics and FA characteristics, White children were more likely to have been introduced to peanut (Odds Ratio (OR) 2.6, 95% Confidence Interval (CI) 1.1-7.2) and milk (OR 2.7, CI 1.1-6.7) at ≤ 6 months, compared to Black children (Table E1). Delay of introduction (> 11 months of age) was less likely among White children for peanut (OR 0.1 3, CI 0.1-0.5), and milk (OR 0.2, CI 0.1-0.6) compared to Black children. Egg was not statistically significant for early or delayed introduction. As visualized in Figure E1, racial differences in timing of egg introduction adjusting by categorical birth year, participants born between 2017-2019 were more likely to have been introduced to peanuts at ≤ 6 months (OR 6.3, CI 1.5-44.4) and less likely to have delayed peanut introduction (OR 0.1, CI 0.01-0.2) compared to children born before 2008. There were no differences in early introduction of peanut, egg, and milk by gender among children born between 2008-2016 compared to children born before 2008.

This study is the first to explore racial differences in common food allergen feeding practices during infancy, where Black children were less likely introduced to peanut and cow's milk during the first year of life compared to White children. The observed differences in infant introduction timing of peanut, milk, and egg in this study may relate to the growing burden of and increased prevalence of FAs among Black children.[1,3,7,8] Nearly 89% of Black children with peanut allergy were not introduced to peanuts by 1 year of age or never introduced to peanuts compared to 67% of White children with peanut allergy. It is unclear if decisions to withhold or delay peanut feeding were due to varying pediatric clinician recommendations, identification, and management of high risk for FAs, parental fears of introducing allergens, cultural practices among respondents, and/or high allergic sensitization to peanut. It is possible that differences in knowledge regarding the safety and effectiveness of early allergen introduction for prevention varies among parents/caregivers. Previous literature suggests that while caregiver knowledge about pediatric FAs is generally suboptimal, misperceptions were more frequently reported among racial/ethnic minority respondents and those reporting lower household income.[9]

This study has several limitations. Although FORWARD is a prospective cohort study, these data were collected at study baseline, at least 3 years after the child's birth. Additionally, a greater proportion of Black children were born before 2008, a smaller proportion of

Black children were born between 2017-2019 and the mean age of Black children was 1.6 years older than White children in the study. Therefore, recall bias is possible and may be differential by race, despite adjustment for child age in the regression models. Selection bias is also possible, however the survey completion rate among eligible respondents in the study was >95% and low rates of missingness were observed (<3% for all variables). Furthermore, the case definitions applied for peanut, milk, and egg allergy relied fully on parent/caregiver-report, which may result in false positive cases.

Our study underscores the need to better characterize racial and cultural differences by examining if barriers and facilitators exist to “early” introduction of food allergens to infants, which may inform culturally specific strategies to educate families on the benefits of early introduction of common food allergens. It is necessary to explore how physician recommendations for early introduction of food allergens influence parents’ decision to introduce foods, and the method of food introduction. Finally, the fact that many caregivers in this cohort of FA patients nevertheless reported introducing allergenic proteins “early,” suggests that further work is needed to better characterize the dietary exposures of diverse samples of allergic and non-allergic patients. Such work has the potential to inform ongoing intervention studies to determine the ideal timing of allergenic protein introduction during early childhood and support targeted interventions to reduce FAs in diverse pediatric populations, as well as optimize dosing, frequency, preparation, and dietary patterns for FA prevention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Conflicts of Interest:

Dr. Christopher Warren has served as an epidemiological consultant for Alladapt Immunotherapeutics

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Clinical Implications:

Exploring racial differences in parent/caregiver-reported timing of peanut, milk, and egg introduction may help better characterize factors influencing racial differences in the prevalence of food allergy (FA) and inform interventions to prevent FA among diverse populations.

Table 1:

Sociodemographic and Food Allergy Characteristics of FORWARD Participants

	All Participants N=632	Black Participants N=234	White Participants N=398	X^2; P value
Gender				
Male	242 (38.1%)	79 (34.1%)	163 (40.3%)	X^2=2.2; P = .14
Female	394 (61.9%)	153 (65.9%)	241 (59.7%)	
Birth Year				
Before 2008	81 (13.0%)	39 (17%)	42 (10.6%)	
2008-2017	423 (67.8%)	164 (71.6%)	259 (65.6%)	X^2= 19.9; P < .001
After 2017	120 (19.2%)	26 (11.4%)	94 (23.8%)	
Child Age Mean(SD)	6.0 (3.7)	7.0 (3.6)	5.4 (3.5)	T=5.5 P<.001
Site				
Ann & Robert H. Lurie Children's Hospital of Chicago	212 (33.5%)	68 (29.1%)	144 (36.2%)	
Rush University Medical Center	128 (20.3%)	73 (31.2%)	55 (13.8%)	X^2= 30.5; P < .0001
Children's National Hospital	138 (21.8%)	51 (21.8%)	87 (21.9%)	
Cincinnati Children's	154 (24.4%)	42 (17.9%)	112 (28.1%)	
Household Income				
<$50,000	132 (21.4%)	115 (52.3%)	17 (4.3%)	
$50,000 - $99,999	95 (15.4%)	40 (18.2%)	55 (13.9%)	
$100,000-$149,999	96 (15.6%)	23 (10.5%)	73 (18.4%)	
$150,000-$199,999	58 (9.4%)	6 (2.7%)	52 (13.1%)	X^2= 232.6; P < .0001
$200,000-$299,999	90 (14.6%)	10 (4.5%)	80 (20.2%)	
>$300,000	85 (13.8%)	5 (2.3%)	80 (20.2%)	
Decline to Answer	61 (9.9%)	21 (9.5%)	40 (10.1%)	
Highest parental education attained by respondent				
Some high school, no diploma	9 (1.5%)	8 (3.6%)	1 (0.3%)	
High school or equivalent	43 (7.0%)	37 (16.8%)	6 (1.5%)	
Some college, no degree	90 (14.6%)	67 (30.5%)	23 (5.8%)	
Associate degree	37 (6.0%)	23 (10.5%)	14 (3.5%)	X^2 = 182; P < .0001
Bachelor's degree	170 (27.6%)	39 (17.7%)	131 (33.0%)	
Master's degree	181 (29.3%)	35 (15.9%)	146 (36.8%)	
Professional degree	25 (4.1%)	3 (1.4%)	22 (5.5%)	
Doctoral degree	62 (10.0%)	8 (3.6%)	54 (13.6%)	
Type of FA				
Peanut	413 (65.3%)	153 (65.4%)	260 (65.3%)	X^2 = 0; P >.99
Milk	150 (23.7%)	54 (23.1%)	96 (24.1%)	X^2 = 0.1; P =.84
Egg	249 (39.4%)	84 (35.8%)	165 (41.5%)	X^2 = 1.7; P =.19

	All Participants N=632	Black Participants N=234	White Participants N=398	X^2; P value
Comorbid Conditions				
Asthma	236 (38.2%)	128 (57.9%)	108 (27.2%)	$X^2 = 57.0$; $P < .001$
Eczema	506 (81.9%)	184 (83.6%)	322 (80.9%)	$X^2 = 0.54$; $P = .46$
Environmental Allergy	289 (46.8%)	136 (61.8%)	153 (38.5%)	$X^2 = 29.9$; $P < .001$
OAS	51 (8.3%)	22 (10.0%)	29 (7.3%)	$X^2 = 1.0$; $P = .31$

* Some missingness (<5% of cases) was observed for demographic variables, which accounts for the differences between the Ns in row 1 and for specific variables (e.g. household income, educational attainment).

Table 2.

Parent/Caregiver-Reported Age of Introduction of Peanut, Egg and Milk Among Black and White Children in the FORWARD Study

Allergen Introduced	Age of Introduction	Black N (%)	White N (%)	X^2; P Value
Peanut	Never introduced *	45 (29.8%)	92 (35.2%)	
	≤6 months	8 (5.3%)	36 (13.8%)	X^2= 35.8; P < .001
	7-11 months	9 (6.0%)	50 (19.2%)	
	>11 months	89 (58.9%)	83 (31.8%)	
	Median(IQR) in months	*12.0 (12.0-24.0)*	*10.0 (7.0-12.0)*	P& < .001
Milk	Never introduced *	13 (23.6%)	15 (15.8%)	
	≤6 months	12 (21.8%)	39 (41.1%)	
	7-11 months	6 (10.9%)	24 (25.3%)	X^2 = 17.0; P ≤ .001
	>11 months	24 (43.6%)	17 (17.9%)	
	Median(IQR) in months	*12.0 (6.0-12.0)*	*6.0 (2.0-10.0)*	P& < .001
Egg	Never introduced *	36 (43.4%)	48 (29.6%)	
	≤6 months	3 (3.6%)	29 (17.9%)	
	7-11 months	16 (19.3%)	49 (30.2%)	X^2=16.9; P < .001
	>11 months	28 (33.7%)	36 (22.2%)	
	Median(IQR) in months	*12.0 (9.0-12.0)*	*9.0 (7.0-12.0)*	P& < .001

& p value corresponds to Wilcoxon rank-sum test

* Question text: *"Never introduced this food (Child tested positive to this food on skin prick or RAST test "*)

IQR=Interquartile Range

Presented Median (IQR) ages of allergenic solid introduction are restricted to respondents reporting dietary introduction