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Hygienic behavior and allergic sensitization in German adolescents

To the Editor:

According to the "hygiene hypothesis," frequent baths/showers and antimicrobial components in personal care products can alter skin microflora,¹ leading to immune system impairment and allergic sensitization.² The human skin provides a vital protection against the external environment. While frequent washing of hands, frequent baths/showers, and use of soap and detergents aggravate the degradation of skin epithelium barrier,³ excess moisturizing of the skin makes it more sensitive to breakdown and increases permeability to foreign agents. Furthermore, almost all personal care products contain antimicrobial agents such as triclosan and/or parabens, which have been reported to have immune modulating properties in skin tissues and have the potential to induce or augment allergic disease.⁴ A degraded skin barrier through frequent baths/showers may result in a higher absorption of these chemicals into the body. To our knowledge, to date, no study has investigated the association between personal hygiene habits, such as frequent baths/showers and use of skin creams, and allergic sensitization.

For the current analysis, we used data collected mainly at the 15-year follow-up of the German GINIplus and LISA cohorts. Ethical approval for both cohorts was granted by the local ethics committees, and informed consent was obtained from all families. Study methods are described in Online Supplement S1, and a flowchart of study participants is provided in Figure S1. We investigated cross-sectional associations between (i) having frequent baths/showers and (ii) use of facial or (iii) body cream on allergic sensitization to aeroallergens and food allergens while adjusting for potential confounders. Allergic sensitization was defined as a specific IgE value above 0.35 kU/L against a battery of 14 allergens. Our main analysis included subjects without "current allergies," defined as parent report of doctor diagnosis of asthma, eczema, or allergic rhinitis during the last 12 months at the age of 15 years. The reason behind exclusion of participants with "current allergy" was to reduce impact of reverse causation. It is likely that people who already had "current allergies" may have changed their bathing habits and use of cream. For example, someone already has eczema may use excessive amount of body creams compared to a person without eczema. Additionally, we repeated the analyses for subjects who did not report ever allergy and for the complete population. We also checked whether the associations were modified by sex.

The majority of participants (52.0%) were living in the Munich area. Three percent reported having less frequent (once per week or more rarely) baths/showers, 26% never using facial cream, and

35.2% never using body cream. The prevalence of current aeroallergen and food allergen sensitization was 45.7% and 10.9%, respectively (Table 1). Of the 15-year participants, 13.9% reported current allergy.

In our main analysis concerning adolescents without current allergies, we observed a protective effect for having baths/showers less than or equal to once per week and aeroallergen sensitization, compared to having baths/showers every day (aOR 0.51 95% CI 0.27, 0.98) (Table 2). However, these associations were no longer significant after participants with ever allergy were excluded. Results for the complete cohort are given in Table S2. There was no evidence of an association between use of facial or body cream and allergic sensitization (Table 2). Further, we did not observe an association between having frequent baths/showers and food allergen sensitization (Table 1). Even though females were more likely to have frequent baths/showers and use facial/body creams, we observed no evidence for a modifying effect by sex for the effects of having frequent baths/showers or use of creams on allergic sensitization (Table S3, 4 & 5).

We observed a significant protective effect of having less frequent baths/showers and aeroallergen sensitization in adolescents who did not report current allergies. This may be explained by less damage to the skin barrier and maintenance of healthy population of commensal microbiome on the skin in adolescents having less frequent showers/baths. Hygiene habits, including use of soap and detergents in baths/showers, accelerate epidermal barrier breakdown and result in an elevated pH level in the *stratum corneum*. A sustained increase in skin pH can cause damage to skin proteins and lipids. This may cause tightness, dryness, barrier damage, irritation and itching, allowing entry of foreign agents such as environmental allergens into the skin, which can then increase skin immune responses.⁵ Animal studies that used mechanical disruption of skin and allergen exposure have shown elevated antigen specific IgE and IgG1 responses in skin⁶; similar mechanisms can be expected in damaged human skin. Frequent baths/showers can influence microbiome diversity on skin epithelial cells, which leads to an altered immune response. These effects have been seen in some infant studies, but there is limited evidence for the immunoregulation and skin microbiome association in adults.²

To our knowledge, there is no evidence in the published literature of the association between frequent baths/showers, as well as use of creams, and allergic sensitization. Nevertheless, some studies have investigated urine levels of parabens and triclosan in relation to allergic sensitization. Two US studies found that higher triclosan

Characteristics of the study sample		Frequency	%
Study area	Munich	1433	52.01
	Leipzig	272	9.87
	Bad Honnef	113	4.10
	Wesel	937	34.01
Study	GINIplus observation	897	32.56
	GINIplus intervention	891	32.34
	LISA	967	35.10
Sex	male	1385	50.27
	female	1370	49.73
Current allergy at 15 y ^a	no	2256	86.11
	yes	364	13.89
Ever reported allergy ^b	no	1483	53.83
	yes	1272	46.17
Socio-economic status ^c	low	166	6.03
	medium	869	31.54
	high	1720	62.43
Parent atopy ^d	no	1099	39.89
	yes	1656	60.11
Having baths/showers	never/less than once per week/once per week	68	2.47
	2-6 times per week	1537	55.79
	every day	1150	41.74
Use of facial cream	never	704	26.00
	often	1206	44.00
	every day	825	30.16
Use of body cream	never	975	35.60
	often	1489	54.36
	every day	275	10.04
Aeroallergen sensitization ^e	no	1497	54.34
	yes	1258	45.66
Food allergen sensitization ^f	no	2455	89.11
	yes	300	10.89
Aeroallergen or food allergen sensitization ^g	no	1457	52.89
	yes	1298	47.11

TABLE 1 Study characteristics of the subjects from GINIplus and LISA cohorts used for this statistical modeling (n = 2755)

^aDefined as parent report of doctor diagnosis of asthma, eczema, or allergic rhinitis during the last 12 mo at 15 y of age.

^bDefined as parent report of doctor diagnosis of asthma, eczema, or allergic rhinitis ever during 3-15 y of age.

^cDefined as the highest number of years of school education of either parent: <10 y vs =10 y vs >10 y, according to the German educational system.

^dDefined as parent's eczema, allergic rhinitis, or asthma before birth of child.

^eDefined as specific IgE value above 0.35 kU/L against SX1 allergens: house dust mites, cats, dogs, mold, birch, rye, mugwort, and timothy grass.

^fDefined as specific IgE value above 0.35 kU/L against FX5 allergens: milk, peanut, eggs, soya, cod, wheat flour.

^gDefined as specific IgE value above 0.35 kU/L against SX1 or FX5 allergens.

concentrations were associated with increased odds of food sensitization in children; one found the association only in children with eczema⁷ and other only in males.⁸ A Norwegian study reported that urinal triclosan was associated with allergic sensitization against

aeroallergens, but not against food allergen.⁹ Although some studies reported a link between triclosan and food allergen sensitization, we did not find any associations between frequent baths or use of creams, and food allergen sensitization.

TABLE 2 Association between having baths/showers and use of creams, and allergic sensitization in adolescents without current allergies^a (allergic sensitization N = 2255; facial cream N = 2241; body cream N = 2244)

	Aero/food allergen sensitization		Aeroallergen sensitization		Food allergen sensitization		
	OR ^b	95% CI	OR ^b	95% CI	OR ^b	95% CI	n
Baths/showers							
Never/less than once per week/once per week	0.54	0.28, 1.02	0.51	0.27, 0.98	1.27	0.49, 3.31	53
2-6 times per week	1.12	0.94, 1.34	1.11	0.93, 1.32	1.07	0.78, 1.47	1290
Every day	Reference category		Reference category		Reference category		912
Facial cream							
Never	Reference category		Reference category		Reference category		573
Often	1.03	0.82, 1.27	1.02	0.82, 1.26	1.11	0.76, 1.62	988
Every day	1.00	0.77, 1.29	0.96	0.74, 1.25	0.98	0.62, 1.56	680
Body cream							
Never	Reference category		Reference category		Reference category		800
Often	0.98	0.79, 1.21	1.03	0.83, 1.27	0.82	0.57, 1.19	1227
Every day	0.88	0.62, 1.25	0.85	0.59, 1.21	1.00	0.55, 1.83	217

CI, confidence intervals; n, number of participants in each category; OR, odds ratio. Significant associations ($P < .05$) are in boldface.

^aDefined as parent report of doctor diagnosis of asthma, eczema, or allergic rhinitis during the last 12 mo at 15 y of age.

^bAdjusted for study center, cohort, sex, socio-economic status, and parental history of allergy.

The strengths of our analysis include the large population size, prospectively collected data on allergic outcomes, and the availability of detailed information on potential confounders. Although the GINIplus and LISA cohorts are both prospective birth cohort studies, we do not have prospectively collected data on personal hygiene habits and use of creams. Given this limitation and even though we excluded participants with current allergy, we cannot completely rule out reverse causation as a driver of the observed associations. Similarly, the effects we observed cannot be ascribed to the frequency of baths/showers alone, as we do not have information on the use of personal care products such as soap, shampoo. Also, there is a possibility of chance findings of significant associations.

Our study is the first to shed light onto the associations between having frequent baths/showers and use of creams, and allergic sensitization. In the general population, adolescents without allergies who have less frequent baths/showers had a protective effect against aeroallergen sensitization. Use of facial or body creams was not associated with allergic sensitization. Further, sex was not an effect modifier of these associations.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

GB conducted the analyses, interpreted the data, drafted the initial manuscript, and revised the manuscript. IM preprocessed the data. IM, MS, SD, and JH contributed to the design of the analysis and interpretation of the data. MS, SK, IL, CPB, TS, AvB, and DB contributed to the data collection and reviewed the manuscript. JH initiated and supervised the analysis. All authors approved the final manuscript as submitted and agreed to be accountable for this work.



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SUPPORTING INFORMATION

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

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Family-based study reveals decreased abundance of sputum *Granulicatella* in asthmatics

To the Editor,

The search for a bacterial signature in asthma is ongoing.^{1,2} One potential limitation of existing studies is the case-control

study design may not adequately control for baseline variation in the bacterial composition between individuals, which may lead to attenuated association results. Family members generally have relatively similar bacteria composition.^{3,4} It is, therefore, advantageous to adopt a family-based study design to reduce

Abbreviations: FEV1, forced expiratory volume in 1 second; rRNA, ribosomal RNA.