Atopy In Children Of Families With An Anthroposophic Lifestyle

Johan S Aim, Jackie Swartz, Gunnar Lilja, Annika Scheynius, Goran Pershagen

Editorial Introduction

The following Swedish research study comparing the rate of bronchial asthma, allergies, dermatitis and other atopic diseases among Waldorf school pupils and pupils in public schools originally appeared in the May 1, 1999, edition of the British medical journal, *The Lancet*. We reprint it here with permission of *The Lancet*.

The findings indicate that Waldorf/Steiner school pupils were "at a significantly lower risk of atopy" than children attending public schools. The researchers investigated a variety of factors in the lives of the Steiner school pupils which might have contributed to this lower rate of atopy—breastfeeding, lack of immunization, avoidance of antibiotics and medications which reduce fevers, consumption of bio-dynamic and organic foods, and other physical aspects of the children's lives. The researchers called these "anthroposophic lifestyle characteristics" and quantified them as "Steiner units," which they found "generally difficult to interpret."

The study did not attempt in any way to explore the effects of Waldorf education itself on the health and immunity from atopic disease of the children attending Steiner schools. Rudolf Steiner often emphasized the significance of education for the life forces of the developing child, not only during childhood but also as a basis for later health and illness; recent *Research Bulletin* articles as well as research consultations and their proceedings* have focused on this relationship.

Further research is needed to explore the effects not only of the physical surroundings of the child (nutrition, immunizations, medications, etc.) but also the effects of the education itself, including such qualitative aspects as the role of the imagination, the arts, rhythm, speech and movement on the physiological processes of the body and the prevention of illness. Readers may also be interested in *Pathways of Healthy Child Development and Its Obstacles: Meeting the Educational Challenges of the Twenty-first Century*, the recently published proceedings from a 1998 WERI research consultation on this theme.

Susan Howard, Editor

*See "Human Biography and Its Genetic Instrument" in the June, 1999 issue of the *Research Bulletin*, and "Integrating Body With Being: Health, Education, and Child Development," in *Pathways of Healthy Child Development and Its Obstacles: Meeting the Educational Challenges of the Twenty-First Century*, Proceedings of the February, 1998 Research Consultation, both by Michaela Glöckler, MD, and available from WERI.

Summary

Background: Increased prevalence of atopic disorders in children may be associated with changes in types of childhood infections, vaccination programmes, and intestinal microflora. People who follow an anthroposophic way of life use antibiotics restrictively, have few vaccinations, and their diet usually contains live lactobacilli, which may affect the intestinal microflora. We aimed to study the prevalence of atopy in children from anthroposophic families and the influence of an anthroposophic lifestyle on atopy prevalence.

Methods: In a cross-sectional study, 295 children aged 5-13 years at two anthroposophic (Steiner) schools near Stockholm, Sweden, were compared with 380 children of the same age at two neighboring schools in terms of history of atopic and infectious diseases, use of antibiotics and vaccinations, and social and environmental variables. Skin-prick tests were done for 13 common allergens, and we took blood samples from children and their parents for analysis of allergen-specific serum IgE-antibodies.

Findings: At the Steiner schools, 52% of the children had had antibiotics in the past, compared with 90% in the control schools. 18% and 93% of children, respectively, had had combined immunization against measles, mumps, and rubella, and 61% of the children at the Steiner schools had had measles. Fermented vegetables, containing live lactobacilli, were consumed by 63% of the children at Steiner schools, compared with 4.5% at the control schools. Skin-prick tests and blood tests showed that the children from Steiner schools had lower prevalence of atopy than controls (odds ratio 0.62 [95% Cl 0.43-0.91]). There was an inverse relation between the number of characteristic features of an anthroposophic lifestyle and risk of atopy (p. for trend=0.01).

Interpretation: Prevalence of atopy is lower in children from anthroposophic families than in children from other families. Lifestyle factors associated with anthroposophy may lessen the risk of atopy in childhood.

Introduction

Every third child in many industrialized countries has an atopic disorder.[1] Although hereditary factors are important for the risk of developing allergic disorders, the increase in prevalence observed in recent years[2,3] suggests that non-hereditary risk factors must play a substantial part. Immunological data show that different infections can either promote atopy (respiratory syncytial virus infections)[4] or inhibit atopy (measles, hepatitis A, tuberculosis),[5,6,7] A change in childhood infectious diseases, vaccination programmes, or both could partly explain this increase, although studies in Sweden,[8,9] did not show that BCG vaccination protected against atopy.

The immunological role of intestinal microflora in the development of allergy has also been investigated. Children in Estonia have lower rates of atopy than Swedish children and their intestinal microflora contains a larger amount of lactobacilli.[10] *Lactobacillus plantarum*, most common in spontaneously fermented vegetables, can colonise the human intestinal mucosa and affect indigenous strains.[11] Animal experiments and studies in vitro have shown that lactobacilli can change the interleukin profile and inhibit antigen-induced IgE production.[12,13] Infants with milk allergy and atopic dermatitis had milder symptoms and fewer markers of intestinal inflammation if their milk formula was fortified with lactobacilli.[14] Thus, intestinal microflora could play a part in the development of atopy.

The school of anthroposophy (Greek: wisdom about man) was founded in the early 20th century by Rudolf Steiner.[15] Anthroposophy has been applied to education (Steiner schools), medicine, art, architecture, and agriculture (biodynamic farming).[16] Anthroposophical doctors restrict the use of antibiotics, antipyretics, and vaccinations.[17] Most children are vaccinated only against tetanus and polio, and most vaccinations are given later than recommended by the Swedish health authorities. As a result, in Sweden, measles occurs primarily in anthroposophic families.[18] They also consume mostly local foods produced according to biodynamic principles. Vegetables preserved by spontaneous fermentation are a common dietary element, even for small children.[19]

We aimed to compare the prevalence of atopy in children from anthroposophic families, who attend Steiner schools, with that of children at conventional schools.

Characteristics (%)	Steiner schools			Control schools		
	A (n=203)	B (n=92)	Total (n=295)	C (n=194)	D (n186)	Total (n380)
Demographic						
Age (years)						
5-7	69 (34)	43 (47)	112(38)	82 (42)	65 (35)	147 (39)
8-10	76 (37)	37 (40)	113 (38)	60 (31)	75 (40)	135 (36)
11-13	58 (29)	12 (13)	70 (24)	52 (27)	46 (25)	98 (26)
M/F	103/100	49/43	152/143	96/98	85/101	181/199
Risk Factors						
Breast-feeding exclusively ≥4 months	178 (88)	72 (78)	250 (85)	124 (64)	122 (66)	246 (65)*
Household pets	165 (81)	68 (74)	233 (79)	138 (71)	137 (74)	275 (72)
Maternal smoking (≥1 cigarette/day)	37 (18)	34 (37)	71 (24)	37 (19)	39 (21)	76 (20)
Antibiotics	101 (50)	52 (57)	153 (52)	172 (89)	171 (92)	343 (90)*
Antipyretics	77 (38)	39 (42)	116 (39)	168 (87)	171 (92)	339 (89)*
MMR vaccination	22 (11)	30 (33)	52 (18)	181 (93)	172 (93)	353 (93)*
Any vaccination	184 (91)	85 (92)	269 (91)	193 (99)	186 (100)	379 (100)*
Measles history	144 (71)	36 (39)	180 (61)	2 (1)	2 (l)	4 (l)*
Fermented vegetables	137 (68)	49 (53)	186 (63)	7 (4)	10 (5)	17 (5)*
Organ ic/biodynamic food	164 (81)	59 (64)	223 (76)	12 (6)	10 (5)	22 (6)*
Paternal atopy						
Heredity by history						
Mother	56 (28)	26 (28)	82 (28)	52 (27)	66 (36)	118 (31)
Father	47 (23)	24 (26)	71 (24)	58 (30)	39 (21)	97 (26)
Both	11 (5)	11 (12)	22 (8)	13 (7)	18 (10)	31 (8)
Blood sample taken from parent	188 (93)	75 (82)	263 (89)	179 (92)	163 (88)	342 (90)
Heredity by blood sample						
Mother	47(23)	23(25)	71(24)	49 (25)	43 (23)	91 (24)
Father	28(14)	10 (11)	38(13)	49 (25)	30 (16)	80 (21)

MMR = measles, mumps, and rubella vaccination. *p <0.001.

Table 1: Demographic data and risk factors for atopic disease in children from Steiner schools and control schools

Our study was approved by the local research ethics committee, and oral informed consent was obtained for each child.

Methods

In a cross-sectional study, children from two Steiner schools (A, B) in a village located 60 km south of Stockholm, Sweden, were compared with children from two control schools (C, D) in the same area. Steiner school A is

situated in the countryside, in buildings constructed in the 1970s in the typical anthroposophic style. School B is located in a traditional school building from the 1930s in a built-up area. School C, adjacent to school B, was built in the 1960s, and school D is in a nearby village and was built in 1995.

All parents of children born in 1982-92 and enrolled in one of the four schools received basic information about our study by post. Those who agreed to participate were mailed a questionnaire on atopic symptoms, and on social and environmental variables. Information on history of infectious diseases and vaccinations was based generally on Child Welfare Centre data, which were available for all children.

Each child was clinically classified with respect to asthma, allergic rhinoconjunctivitis, atopic dermatitis, food allergy, and allergic urticaria. Between April, 1997, and October, 1997, clinical examinations were done. Two doctors (JSA, JS) worked in parallel in each school and alternated between the two types of schools. We defined bronchial asthma as three or more episodes of wheezing before 2 years of age, or one episode from 2 years of age, or any episode of wheezing independent of age, if combined with atopic symptoms in the family or other atopic symptoms in the child. Allergic rhinoconjunctivitis was diagnosed if rhinitis or conjunctivitis appeared at least twice after exposure to a particular allergen and was unrelated to infection. Food allergy or allergic urticaria was diagnosed as acute onset of symptoms such as skin reactions, wheezing, vomiting, or diarrhoea on more than one occasion after ingestion or contact with a particular type of food or allergen. Atopic dermatitis was defined according to Hanifin and Rajka[20] and assessed by use of the SCORAD index.[21]

We did a skin-prick test on the volar side of each child's lower arm according to manufacturer's instructions (ALK, Copenhagen, Denmark). The test included allergens for cladosporium, *Dermatophagoides pteronyssinus*, cat, dog, horse, birch, timothy grass, and mugwort (Soluprick, 10 Histamine equivalent potency, ALK), egg white (Soluprick, weight to volume ratio 1 to 100), codfish (Soluprick, 1 to 20), peanut (Soluprick, 1 to 20), cow's milk (3% fat, standard foodstuff), and soy bean (Soja Semp, Semper AB, Stockholm, Sweden). Histamine chloride 10 mg/mL (Soluprick) was used as the positive control, and the allergen diluent was the negative control. The test was judged positive if the weal was at least 3 mm in diameter and greater than or equal to the histamine-induced weal after 15 mm. We used the same batches of individual extracts, and the tests were done by the same two nurses throughout the study, each working in both kind of schools. The nurses were not aware of whether the child was classified as clinically atopic or not.

We took a venous blood sample in a tube coated with edetic acid from each child and from one of their parents-primarily the one most likely to have a history of atopy. Blood samples were centrifuged at 1200*g*, and plasma was separated and stored at -18 C before analysis. We tested samples for circulating IgE antibodies against 11 common inhalant allergens (Phadiatop: cladosporium, *Dermatophagoides farinae*, *D pteronyssinus*, cat, dog, horse, birch, timothy grass, mugwort, olive, *Parietaria judaica*, six food allergens (fx5: hen's egg white, codfish, cow's milk, peanut, soy bean, wheat flour), and five rodent allergens (ex7O: guinea pig, rabbit, hamster, rat, mouse) according to manufacturer's instructions (Pharmacia Upjohn Diagnostics AB, Uppsala, Sweden). In accordance with Pepys' definition,[22] children with at least one positive skin-prick test for any of the selected allergens, or for Phadiotop, fx5, or ex7O, were judged to be atopic.

We analysed data by use of Stata 5.0 software (Stata Corporation, College Station, TX, USA), and estimated odds ratios and 95% CIs of atopy by logistic regression analyses. 95% CIs and p values (Wald test) were based on an estimator of variance that relaxed the assumption of independence between observations within families.[23] A summary measure included 15 lifestyle exposures characteristic of the anthroposophical lifestyle in childhood ("Steiner units"), defined as no measles, mumps, and rubella vaccination, none of seven other vaccinations before 6 months old, antibiotics not more than twice, and not before 2 years old, antipyretics not more than twice, and not before 6 months old, consumption of fermented vegetables, consumption of these at least for a year, and consumption of mainly organic or biodynamically produced food in early childhood.

Results

675 children aged 5-13 years took part in the study. In the Steiner schools, parents of 13 (4.2%) of 309 children refused to participate, 296 families were sent the questionnaire, and only one family refused to take part in the clinical study. In control schools, parents of 16 (3.9%) of 413 children refused to participate, 397 families were sent the questionnaire, and 17 (4.3%) refused the clinical study. Demographic data and risk factors for atopic disease in children at the four schools are presented in table 1. Only half of the children at the Steiner schools had ever received antibiotics, compared with 90% in the control schools. A similar pattern is apparent for use of antipyretics. Immunization against measles, mumps, and rubella had been given to only 18% of the children at the Steiner schools, compared with 93% at the control schools. As a result, 71 % of the children at the most typical Steiner school (A) got measles during an epidemic in 1995.

Fermented vegetables had been consumed by 63% of the children at the Steiner schools, compared with only 4.5% in the control schools. A similar pattern was shown for consumption of organic or biodynamic food during childhood. Breast feeding in infancy was of longer duration for children in Steiner schools than for controls (mean 5.7 months, Steiner, vs 4.3 months, controls). There were, however, no clear differences in other risk factors for atopy between the two groups, such as age, patterns of heredity, sex, parental smoking, or pets in the household. Families of children in the Steiner schools had on average slightly more children than families of those in the control schools (2.8 vs 2.5 children, respectively), and their children had a higher birth order (2.1. vs 1.8, data not shown).

	Steiner schools			**Control schools**		
	A (n=203)	**B** (n=92)	**Total** (n=295)	**C** (n=194)	**D** (n=186)	**Total** (n=380)
Clinical symptoms or history of atopic disease						
Total	25	14	39 (13%)	50	46	96 (25%)***
Bronchial asthma	11	6	17 (5.8%)	27	38	65 (17%)***
Previous atopic dermatitis	12	3	15 (5.1%)	15	16	31(8.2%)
Current atopic dermatitis	4	4	8 (2.7%)	20	14	34 (8.9%)***
Allergic rhinoconjunctivitis	13	8	21 (7.1%)	29	26	55 (14%)**
Food allergy	1	2	3 (1.0%)	2	2	4 (1.1%)
Urticaria	3	0	3 (1.0%)	1	2	3 (0.8%)
Skin-prick test						
Test done	201	91	292 (99%)	191	185	376 (99%)
Any positive result	15	6	21(7.2%)	30	20	50 (13%)’
Pets with fur	15	3	18 (6.2%)	22	12	34 (9.0%)
Pollens	10	2	12 (4.1%)	23	15	38 (10%
Foodstuffs	1	1	2 (0.7%)	4	5	9 (2.4%
D pteronyssinus and/or cladosporium	2	3	5 (1.7%)	2	1	3 (0.8%
Blood sample						
Sample taken	188	83	271 (92%)	169	165	334(88%)
Any positive test	40	25	65 (24%)	57	53	110 (33%)*
Positive in Phadiotop	35	22	57 (21%)	45	45	90 (27%)
Positive in fx5	15	10	25 (9.2%)	29	23	52 (16%)*
Positive in ex 70	6	0	6 (2.2%)	3	4	7 (2.1%)

Overall atopy classification						
Data available	188	83	271 (92%)	172	165	337 (89%)
Total atopic	41	25	66 (24%)	61	54	115 (34%)*

*p <0.05; **p < 0.01; ***p< 0.001.

Table 2: Signs of atopy according to clinical examination, skin-prick test, and blood tests in children from Steiner schools and control schools

In the Steiner schools, 13% of children had a history of atopy or of symptoms consistent with atopy, compared with 25% of children at the control schools (p<0.001). The difference was most pronounced for current atopic dermatitis and bronchial asthma (table 2). The prevalence of reported wheeze in the last 6 months was 3.1% among children in the Steiner schools and 7.6% for those in the control schools. Reported asthma diagnosed by a doctor occurred in 2.7% and 9.5% of children, respectively, and wheeze "ever" was reported for 7.1% and 17.1% of children, respectively. The prevalence of positive skin prick tests was 7% and 13%, respectively (p=0.02), and a similar prevalence was shown when response was not related to the size of the histamine weal. Results based on the degree and severity of sensitization, as assessed by the number of positive skin-prick-test reactions or the sum of weal sizes, were consistent (data not shown).

24% of the children in Steiner schools had positive blood-test reactions, compared with 33% in the control schools (p=0.02). Positive reactions against airborne allergens (Phadiatop) were most frequent, mainly among children in the control schools. There was a marked difference in positive reaction to food allergens (fx5) between Steiner children and controls (p=0.02). Combining the results from the skin-prick test and the blood test, 24% and 34% of children were atopic in the Steiner and control schools, respectively (p=0.01). A similar pattern was shown if we used higher cut-off levels in the serological tests.

Risk factor	**Atopy** (n=181)	**No atopy** (n=427)	**Odds Ratio** (95% CI)
Steiner-school pupil	66	205	0.62 (0.43 - 0.91)
Breastfed exclusively ≥ 4 months	124	323	0.73 (0.48 - 1.11)
Antibiotics never	137	302	0.76 (0.50 - 1.16)
Antipyretics never	124	267	0.77 (0.52 - 1.14)
No MMR vaccination	118	236	0.67 (0.46 - 0.99)
Measles	46	135	0.73 (0.48 - 1.11)
Fermented vegetables ever	48	139	0.75 (0.50 - 1.12)
Mainly organic or biodynamic food in childhood	54	174	0.63 (0.42 - 0.94)
7-10 Steiner units*	56	119	0.93 (0.59 - 1.46)
11-15 Steiner units	45	157	0.56 (0.36 - 0.87)
Heredity (blood test)	85	135	2.21 (1.47 - 3.32)
Sex (male)	113	195	2.12 (1.43 - 3.14)

Odds ratios adjusted for heredity and sex. MMR = measles, mumps, and rubella vaccination. *See text for explanation.

Table 3: Odds ratios for atopy (95% CI) associated with exposure to factors typical for children in Steiner schools, plus heredity and sex

Comparison of atopic children with nonatopic children in terms of the characteristics of an anthroposophic lifestyle (table 3) showed that heredity and male sex were the greatest risk factors for atopy. Logistic regression showed that children from Steiner schools were at significantly lower risk of atopy (odds ratio 0.62 [95% CI 0.43-0.91]). Analyses based on comprehensive models, which included several characteristics of the anthroposophic lifestyle ("Steiner units"), were generally difficult to interpret because of strong correlations between different exposures. In analyses based on models that included the characteristic exposures separately, a tendency to negative correlation with atopy was shown consistently. There was an inverse relation between the number of anthroposophic lifestyle characteristics and atopy risk (p for trend=0.01). In the group of children with more than ten out of 15 characteristic lifestyle features, the odds ratio for atopy was 0.56 (95% CI 0.36-0.87). The same trend was shown when the analysis was restricted to children from the Steiner schools only.

Discussion

We have shown that factors associated with an anthroposophic way of life are also associated with a lowered prevalence of atopy in children, both by clinical diagnosis and by serological or skin-prick diagnosis. However, several issues have to be considered in the interpretation of these findings. Measles has been inversely related to atopy,[24] and a measles epidemic in 1995 could have played a part in the lower prevalence of atopic dermatitis in children at the Steiner schools than in children at control schools. Measles infection has obvious symptoms, and in our study the same doctor (JS) verified every case in the local epidemic. Given the restricted use of vaccinations and antibiotics, other infectious diseases could also have been more frequent in children with an anthroposophical lifestyle. These other diseases are, however, generally more difficult to verify by history and their roles in atopy are uncertain. Dietary factors may have been important in the lower prevalence of atopy in children at the Steiner schools than in children at control schools. Frequent consumption of fermented vegetables may affect the intestinal microfiora, and the difference in duration of breast-feeding may have an influence on risk of atopy, although the protective effect of breastfeeding in the age group under study is uncertain.[25] Other characteristics of an anthroposophic lifestyle, which were not investigated, could also have contributed to the differences in atopy between study groups.

We could not identify a single lifestyle exposure factor primarily responsible for the lower prevalence of atopy in children at the Steiner schools, because behavioural characteristics of an anthroposophical lifestyle are strongly correlated. Furthermore the cross-sectional study design has limitations in that relevant exposures occurred several years beforehand and may thus have been reported with uncertainty, possibly including bias related to occurrence of atopy.[26] However, an anthroposophical lifestyle mainly resulted from parental choice, and was experienced by the children during their whole life.

Non-response rates were similarly low in the two groups of children. Our controls were representative of the general population, since the prevalence of traditional risk factors, clinical atopy, positive skin-prick tests, and positive blood tests was similar to that in other Swedish studies.[27],[28],[29],[30] Selection of children to attend Steiner schools may have been related to atopy, but we believe that this was unlikely.

Lifestyle factors related to the anthroposophic way of life appear to lessen the risk of atopic disease in childhood. Since that way of life involves several characteristics that were more common in the general population some decades ago, our study may help to explain the recent increase in atopy. Further studies in this group of children would help to assess strategies of allergy prevention.

Contributors

Johan S Aim, Jackie Swartz, Gunnar Lilja, Annika Scheynius, and Goran Pershagen were all involved in study planning, data analysis, and preparation of the paper. The clinical part of the study was done by Johan S Alm and

Jackie Swartz. Paediatric allergology was done by Gunnar Lilja. Annika Scheynius was responsible for immunology. Epidemiology was primarily handled by Goran Pershagen.

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Authors

Department of Laboratory Medicine, Division of Clinical Immunology (J S Aim MD, Prof A Scheynius MD), Karolinska Institute and Hospital; and Division of Environmental Epidemiology, Institute of Environmental Medicine, Karolinska Institute (Prof G Pershagen MD), Stockholm; Vidar Clinic, Jarna (J Swartz MD); and Sachs' Children's Hospital, Stockholm (G Lilja MD, J S Aim), Sweden

Correspondence to: Dr Johan S Aim, Sachs' Children's Hospital, Box 179 12, S-118 95 Stockholm, Sweden (e-mail: Johan.Alm@sos.ki.se)

Credit

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