

Left-handedness in asthmatic children

Krommydas G, Gourgoulisanis KI, Andreou G, Molyvdas P-A.
Left-handedness in asthmatic children.
Pediatr Allergy Immunol 2003; 14: 234–237. ©2003 Blackwell Munksgaard

Left-handedness has been associated with asthma and allergic disorders. The Geschwind–Behan–Galaburda (GBG) hypothesis could explain this association. In view of previous findings, we investigated the distribution of laterality scores among asthmatic children and controls aged 4–8 years old. Seventy families with asthmatic children were administered the International Study of Asthma and Allergy in Childhood (ISAAC) questionnaire and the Edinburgh Left-handedness Inventory. A sample of 70 families with non-asthmatic, healthy children was used as controls. The majority of children had mild asthma. Ambidexterity was the main feature in the asthmatic children. A statistically significant difference in the laterality quotient (LQ) distribution was found in the group of asthmatic children with allergic rhinitis (LQ mean value in the asthmatic children with allergic rhinitis: 42.85 vs. 79.50 in the rest of the asthmatic children). These results suggest that there is a tendency towards left-handedness in asthmatic children and lend support to the GBG hypothesis.

Georgios Krommydas¹, Konstantinos I. Gourgoulisanis², Georgia Andreou³ and Paschalis-Adam Molyvdas¹

¹Lung Function Laboratory, Physiology Department, Medical School, University of Thessaly, ²Pulmonary Department, Medical School, University of Thessaly, ³Department of Special Education, University of Thessaly, Larissa, Greece

Key words: asthma; allergic rhinitis; left-handedness; eczema; childhood

K. I. Gourgoulisanis, Associate Professor, Medical School, University of Thessaly, Papakyriazi 22, Larissa 41222, Greece
Tel.: +30 41 623057
Fax: +30 41 670240
E-mail: kgourg@med.uth.gr

Accepted 26 June 2002

Allergic diseases and asthma have been associated with left-handedness (1, 2). The Geschwind–Behan–Galaburda (GBG) hypothesis suggests that high levels of testosterone during fetal life result in the development of left-handedness by delaying the growth of the left-hemisphere, while at the same time affect the development of thymus, favoring the appearance of immune disorders and allergic diseases early in life (3). A link between gender and handedness has also been proposed. Studies report a preponderance of males among left-handers (1).

In view of these findings, the distribution of laterality scores among asthmatic children of preschool age who attended public nursery schools was investigated. The distribution of laterality scores among asthmatic children who also had allergic rhinitis was examined as well.

Materials and methods

Eight hundred and sixty-three families with a child attending a public nursery school in Larissa were administered a brief asthma questionnaire. Larissa is a town of 150 000 urban population in the middle of Greece. The survey included the

seven public nursery schools in the town. One hundred and twenty out of the 754 families that responded were found to have at least one child with respiratory symptoms consistent with asthma in the previous year. These families were asked to fill in the International Study of Asthma and Allergy in Childhood (ISAAC)-phase I questionnaire (4) in order to obtain an accurate estimation of the frequency of asthma and other allergic disorders. Seventy families were screen positive for asthma. Left-handedness was studied through the Edinburgh Handedness Inventory (5). Fifty-four families (54/70, 77%) completed the left-handedness questionnaires. As a control group, 70 families with healthy children were randomly selected from the same public nursery school and were matched for age and sex. Fifty-six parents filled in the left-handedness inventory. The asthmatic children who completed the left-handedness questionnaires were also searched for allergies other than asthma. The 22 asthmatic children found to suffer from allergic rhinitis or eczema, were further divided into groups according to the allergies they suffered from. Fourteen asthmatic children were presented with allergic rhinitis.

Assessment of asthma and allergies

To evaluate asthma, the ISAAC-phase I questionnaire was used. To evaluate the severity of asthma, the Global Initiative for Asthma (GINA) guidelines were used. To confirm asthma attacks, a visit to a hospital emergency room, an admission to hospital or a visit to a physician's office was taken into account. A mild attack managed at home was included but only if the pediatrician diagnosed it as so. This was defined as an exacerbation of the disease, where high doses of medication were necessary.

Assessment of handedness

Left-handedness was examined through the Edinburgh Left-Handedness Inventory (5). The handedness of each individual was determined according to the formula $LQ \text{ (laterality quotient)} = (R - L) * 100 / R + L$, where R and L stands for right and left, respectively. Each question had 10 points. R and L represent the sum of points of the questions. The range of quotients was -100 for extreme left-handedness to +100 for extreme right-handedness. The criterion $LQ < 0$ was taken to indicate left-handedness in this experiment, in accordance with Oldfield (5). Children were asked to carry out the tasks described in the questionnaire in the presence of the interviewer. In some cases it was not possible to come into contact with the children. These cases were excluded from the study.

All questionnaires were completed in the presence of the interviewer, who was a physician, and the interview had a duration of 1 h.

Variables and data analysis

Frequency tables were used to describe the distribution of the LQ. The independent Stu-

dent's *t*-test was used for the statistical analysis of the distribution of the laterality quotient between the asthmatic and non-asthmatic children, as well as within the subgroups of the asthmatic children. Levene's test for equality of variance was also executed. When a F-value indicated a statistical difference of the variances of the LQ distribution in the different groups, the Student's *t*-test was not performed. The Mann-Whitney *U*-test, a non-parametric test, was executed instead (6). Statistics were processed using SPSS for Windows, 7.5 Version (Standard Version, 1996, SPSS Inc., Chicago, IL, USA).

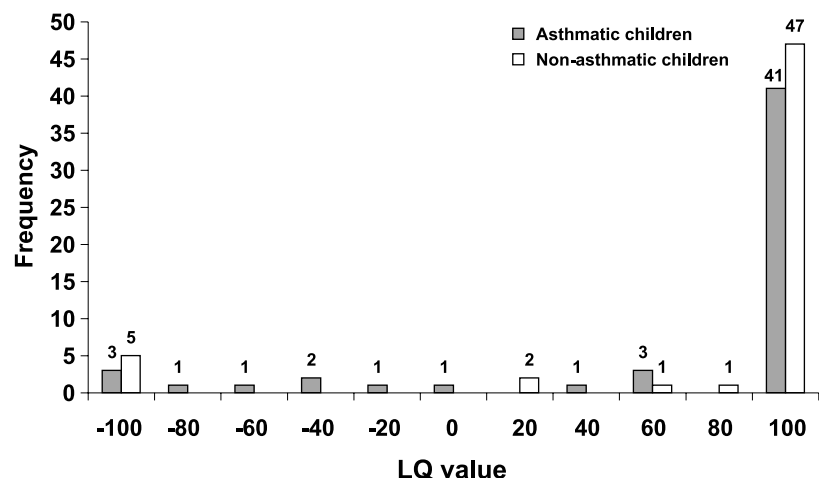
Results

The experimental group consisted of 70 families with one asthmatic child each. Males represented approximately 46% of the children. The mean age of the children was 5.9 (± 1.17) years while their mother's and father's were 34.5 and 39.3 years, respectively.

The majority of the children presented with mild asthma, according to GINA guidelines. 74.3% of the children had only one attack in the previous year. 75.7% had no admission to hospital and 15.7% were admitted to hospital only once. Eczema and allergic rhinitis were reported in 14.2% and 31.4% of the children, respectively.

The distribution of LQ in the two groups of asthmatic and non-asthmatic children is shown in Fig. 1. Left-handedness reached 14.8% in asthmatics and 8.9% in non-asthmatics. Almost all (-) values were represented in the group of asthmatic children. Eight left-handed children were found in the group of the asthmatic children. Nine asthmatic children scored between -60 and 60 and could therefore be regarded as Inconsistent Mixed Handed individuals (ambidextrous),

Fig. 1. Laterality quotient (LQ) frequency in asthmatics and non-asthmatics.



in accordance with Gaillard and Satz (7). Only three children in the non-asthmatic group achieved this score. Despite the tendency towards left-handedness in the group of asthmatic children, the difference failed to reach significance ($LQ - \text{Mean} \pm \text{SD}$ in asthmatic children: 70.00 ± 61.64 , $\text{Mean} \pm \text{SD}$ in non-asthmatic children 78.21 ± 58.49 , $p = 0.47$).

Table 1 shows the parameters of LQ distribution in the two groups of asthmatic children with allergic rhinitis and the rest of the asthmatic children. A statistical difference in the variance of LQ distribution was established in the group of asthmatic children with allergic rhinitis (LQ mean value in the asthmatic children with allergic rhinitis: $42.85 (\pm 81.47)$ vs. $79.50 (\pm 56.31)$ in the rest of the asthmatic children). The Z-value in the Mann-Whitney U-test reached significance at the 0.05 level ($p = 0.048$). Left-handedness reached 28.5% (4 out of 14) in asthmatic children with allergic rhinitis and 10.0% (4 out of 40) in those without. There were no statistically significant differences in asthmatic children with eczema.

Discussion

In the present study, although we observed a tendency towards left-handedness in the asthmatic children and a tendency towards right-handedness in the controls, the overall distribution of laterality scores between asthmatics and controls failed to reach significance. From this point of view, our results lend no support to previous findings for the coexistence of left-handedness and asthma early in life (1, 2). However, ambidexterity ($-60 \leq LQ \leq 60$) was present in the asthmatic group. Nevertheless, an over-representation of extreme right-handedness ($LQ = 100$) in both groups lead to non-statistically significant differences between asthmatics and non-asthmatics, concerning the overall distribution of laterality scores. A possible explanation of our findings is the ratio of boys and girls, which was almost equal and, as it has been proved previously,

childhood bronchial asthma is more common in males than females early in life (1). Furthermore, children below school age, as was the mean age of our sample, may change hand preference, when they reach school age (9).

There is also some evidence that autoimmunity is related to the degree of left-handedness. It was found that left-handers with at least one autoimmune disease were more strongly left-handed than were those with no incidence of autoimmunity (10). If the GBG model was expanded in order for asthma and other allergies to be included (2), it is possible that mild asthma disease, as was the case in the majority of the child in the sample, is related to low-degree left-handedness or rather ambidexterity. From this point of view, this finding could support the GBG model.

When the group of asthmatic children was divided into subgroups in relation to allergies, a difference of LQ distribution occurs. Left-handedness was the main feature in the group with allergic rhinitis. This is consistent with previous findings (1, 2). Left-handedness is related to atopy, as this is documented by the production of high titers of Ig-E antibodies in reaction to common allergens (2). There are studies, however, that found no association between left-handedness and allergies in adult subjects (8), and this phenomenon may be age-dependent. On the other hand, allergic rhinitis and eczema have different underlying mechanisms. Interleukines (IL)-5 and IL-6 play a critical role in allergic rhinitis, while interferon- γ and T-cell delayed hypersensitivity reaction is the main characteristic in the eczema pathophysiology (11). Perhaps these differences could be attributed to testosterone or to some other factor, which could be responsible for left-handedness as well. Steroids in general may promote some kind of immune reaction and there are mammalian species in which testosterone has a stimulating effect on the immune system, rather than the well-known destructive one (12). It could be that, apart from suppressing thymus, increased levels of testosterone in prenatal life lead also to a shift to the immune system, so that allergic rhinitis occurs later in childhood. Children with asthma who also have allergic rhinitis might represent a subgroup with special pathophysiological features. It would be interesting to investigate the evolution of the disease in these children until adulthood, as they might have a different prognosis. Further studies towards this direction are necessary.

Several biases should be considered in this study. The sample, although randomly selected from the pupils of the public nursery schools,

Table 1. The distribution of laterality quotient (LQ) among asthmatic children with allergic rhinitis and those without ($n = 54$)

LQ		F	p
Asthmatic children with allergic rhinitis ($n = 14$) Mean $\pm$ SD	Asthmatic children without allergic rhinitis ($n = 40$) Mean $\pm$ SD		
42.85 $\pm$ 81.47	79.50 $\pm$ 50.93	8.017	0.007
	Mann-Whitney U-test		
	z-value		p
	-1.975		0.048

may not be representative. For example, parents of a different socio-economic level could prefer private schools. Children with severe asthma, especially males, may attend private schools or no nursery schools at all. In addition, there were no pupils from rural areas in these schools. On the other hand, the sample concerning left-handedness was rather small.

The findings of this study suggest that there is a tendency towards left-handedness in asthmatic children early in life. Mixed handedness rather than extreme left-handedness is determined early in life, probably prenatally in accordance with the GBG theory. Future studies, including larger samples of children of this age, are necessary for the above findings to be confirmed.

References

1. COREN S. Handedness and allergic response. *Int J Neurosci* 1994; 76: 231–6.
2. SMITH J. Left-handedness: Its association with allergic disease. *Neuropsychologia* 1987; 25: 665–74.
3. GESCHWIND N, BEHAN P. Left-handedness: Association with immune disease, migraine and development learning disorder. *Proc Natl Acad Sci USA* 1982; 79: 5097–100.
4. THE INTERNATIONAL STUDY OF ASTHMA AND ALLERGIES IN CHILDHOOD (ISAAC) STEERING COMMITTEE. World-wide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis and atopic eczema: ISAAC. *Lancet* 1998; 351: 1225–32.
5. OLDFIELD RC. The assessment and analysis of handedness. The Edinburgh Inventory. *Neuropsychologia* 1971; 9: 97–113.
6. GLANTZ SA. *Primer of Biostatistics*, 2nd edn. New York: McGraw-Hill 1987.
7. GAILLARD F, SATZ P. Handedness and reading disability: A developmental study. *Arch Clin Neuropsychol* 1989; 4: 63–9.
8. BRYDEN MP, McMANUS IC, BULMAN FLEMING MB. Evaluation the empirical support for the Geschwind-Behau-Galaburda model of cerebral lateralization. *Brain Cogn* 1994; 26: 103–67.
9. HARRIS LJ, CARLSON DF. Pathological left-handedness. An analysis of theories and evidence. In: MOLFESI DL, SEGALOWITZ SJ, eds. *Brain Lateralization in Children: Developmental Implications*. New York: Guilford Press 1988, 289–372.
10. MORFIT NS, WEEKS NV. Handedness and immune function. *Brain Cogn* 2001; 46: 209–13.
11. THRESTRUP-PEDERSEN K, LARSEN CG, RONNEVIG J. The immunology of contact dermatitis. *Contact Derm* 1989; 20: 81–92.
12. BILBO SD, NELSON RJ. Sex steroid hormones enhance immune function in male and female Siberian hamsters. *Am J Physiol Regul Integr Comp Physiol* 2001; 280: 207–21.