ORIGINAL ARTICLES

Attention deficit disorder with developmental coordination disorders

Magnus Landgren, Bengt Kjellman, Christopher Gillberg

Abstract

***Aims*—To analyse the contribution of certain social, familial, prenatal, perinatal, and developmental background factors in the pathogenesis of deficits in attention, motor control, and perception (DAMP).**

***Methods*—A population based case-control study was carried out with 113 children aged 6 years, 62 diagnosed with DAMP and 51 controls without DAMP. The children's health and medical records were studied and their history with regard to background factors was taken at an interview with the mother using a standardised schedule. Familial factors, possible non-optimal factors during pregnancy (including smoking), developmental factors (including early language development), and medical and psychosocial data were scored in accordance with the reduced optimality method.**

***Results*—Low socioeconomic class was common in the group with DAMP. Familial language disorder and familial motor clumsiness were found at higher rates in the DAMP group. Neuropathogenic risk factors in utero were also more common in the children with DAMP. Maternal smoking during pregnancy appeared to be an important risk factor. Language problems were present in two thirds of the children with DAMP. Sleep problems and gastrointestinal disorders, but not atopy or otitis media, were significantly more common in the DAMP group.**

***Conclusions*—Prenatal familial and neuropathogenic risk factors contribute to the development of DAMP. Primary prevention, such as improved maternal health care and early detection or treatment, or both, of associated language problems appear to be essential.**

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Keywords: developmental coordination disorder; attention deficit hyperactivity disorder; motor control and perception; language; prenatal factors; perinatal factors

Department of Child and Adolescent Psychiatry, Göteborg University, Annedals Clinics, S-413 45 Gothenburg, Sweden
C Gillberg

Department of Pediatrics, Skövde Central Hospital, Skövde, Sweden
M Landgren
B Kjellman

Correspondence to: Professor Gillberg.

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Attention deficit hyperactivity disorder (ADHD) and deficits in attention, motor control, and perception (DAMP) are common childhood symptom combinations, each occurring in about one in 20 Swedish children aged 6 years.[1–4] The term DAMP is used in Nordic countries as an operational diagnosis for this combination of deficits in children who do not have mental retardation or cerebral palsy.[5] DAMP and ADHD overlap to a considerable degree.[4] All children with DAMP have the combination of attention deficits—amounting to full ADHD in about half of all cases—and motor perceptual deficits (MPD). Some children with ADHD do not have MPD.[4] The diagnosis of MPD corresponds closely with that of developmental coordination disorder (Kadesjö, Gillberg, unpublished data).[2] DAMP is conceptualised as a neurodevelopmental dysfunction syndrome with a high degree of psychiatric comorbidity.[6 7]

Several reports have shown an association of specific risk factors and neurodevelopmental–neuropsychiatric disorders.[8–10] In a Swedish population study in Gothenburg 20 years ago, urban children diagnosed as having DAMP were found to have a variety of socially non-optimal familial, prenatal, and perinatal potentially brain damaging factors in their histories.[11]

We have now carried out an epidemiological study of 6 year old children living in a small town with rural surroundings (the municipality of Mariestad).[4] We report here the testing of three hypotheses generated in previous studies: (a) hereditary factors play an important part in the pathogenetic chain of events in DAMP; (b) potentially brain damaging risk factors, including smoking in pregnancy and

Table 1 Criteria for deficits in attention, motor control, and perception

A. Attention deficit disorder as manifested by:
(a) Severe problems in at least one, or moderate problems in at least two, of the following areas: attention span, activity level, vigilance, and ability to sit still; and
(b) Cross situational problems in the areas mentioned under (a) documented at two or more of the following: psychiatric, neurological, psychological evaluation, and maternal report

B. Developmental coordination disorder or motor perception dysfunction as manifested by severe:
(a) gross motor dysfunction according to neurological examination,[12] or
(b) fine motor dysfunction according to neurological examination,[12] or
(c) visuomotor/perceptual dysfunction according to testing with the block design and object assembly subtests of the WISC-III[13] (a discrepancy of ⩾ 15 IQ points on any of these relative to overall IQ) or visuomotor dyscoordination test outlined in Rasmussen *et al*[14]

C. Problems not accounted for or associated with mental retardation or cerebral palsy

All of A, B, and C have to be met.

Table 2 Background factors studied; criteria for reduced optimality

Factor	*Optimal*
Family factors (first degree relatives only)	
Speech/language retardation	Absent
Learning disorder	Absent
Motor clumsiness	Absent
Left handedness	Absent
Mental retardation	Absent
Epilepsy	Absent
Tics	Absent
Attention deficit	Absent
Prenatal factors	
Smoking	No
Gestational age (weeks)	37–41
Small for gestational age	No
Large for gestational age	No
Eclampsia/pre-eclampsia	Absent
Antiepileptic drugs	No
Severe infections in pregnancy	Absent
Alcohol exposure	No
Intrapartal factors	
Apgar score	9–10
Vacuum extraction	No
Twins or multiple birth	No
Breech or foot presentation	No
Cord prolapse, around neck/knot	No
Child severely traumatised (fractures, lots of petechiae)	No
Neonatal factors	
Hypoglycaemia	No
Septicaemia/meningitis	Absent
Respiratory distress	Absent
Hyperbilirubinaemia not treated	Absent
Hyperbilirubinaemia treated	Absent
Difficulties regulating temperature	No
Irritable/floppy infant	No
Postnatal factors	
Encephalitis	Absent
Meningitis	Absent
Concussion	Absent
Convulsions	Absent
Social factors	
Social class	I, II, or III[20]
Ethnicity	Parent: Swedish/immigrant
Family structure	Parent: married/divorced/ single Child living with half siblings

low birth weight, contribute to the development of DAMP; and (c) early language problems in preschool children predict a diagnosis of DAMP at the age of 6 years.

Subjects

The DAMP group, 52 boys and 10 girls, comprised all 28 children (25 boys) diagnosed with DAMP (table 1) in the total population of 589 children aged 6 years screened for DAMP in the municipality of Mariestad, and the first 34 children (27 boys) with DAMP recruited after screening covering the surrounding district of Skaraborg.[4] The children from Mariestad and those from the rest of the district were similar with respect to social class, ethnicity, and medical background factors. A comparison group of 6 year old children was randomly selected (separately for boys and girls) among the children screened and assessed as negative for DAMP and coming from Mariestad and the nearby community; this comprised 39 boys and 12 girls.

Methods

SCREENING AND ASSESSMENT

The screening procedures were identical for all children and have been described in detail previously.[4] The screening procedure comprised: the Conners' parent questionnaire; a parent psychomotor questionnaire; a preschool teacher questionnaire; and a standardised motor examination at the child health centre.[15 16] The clinical assessment comprised a detailed history, psychiatric and neurodevelopmental examination, neuropsychological testing, and speech/language evaluation performed by a multidisciplinary team. The examining doctor was unaware of the results of the assessment performed by his team members. The routine paediatric physical examination and the neurodevelopmental examination were performed by the first author in all instances. The methods used have good to excellent interrater and test-retest reliability.[12 16–18]

BACKGROUND FACTORS

The obstetric, child health centre, and medical records of the children were collected and scrutinised according to preset standards. Table 2 shows the criteria of optimality modified from Gillberg and Rasmusen.[11] For each factor with optimal conditions a score of 0 was given and for each factor with non-optimum conditions a score of 1 was given. Smoking in pregnancy was recorded as present in mothers who reported smoking more than the occasional cigarette during pregnancy. Smallness for gestational age and largeness for gestational age were defined as birth weights less than two standard deviations (SDs) and greater than two SDs respectively according to norms of Swedish growth charts.[19] Hyperbilirubinaemia (untreated) was defined as > 150 mmol/l at birth weights less than 2500 g or > 200 mmol/l at birth weights of 2500 g or more. Hypoglycaemia was defined as blood sugar < 1.5 mmol/l. Pre-eclampsia was defined as comprising at least two of the following: albuminuria, high blood pressure (> 140/90 mm Hg), and generalised oedema. Social class was rated on the basis of the father's occupation.[20] In single parent families, the rating was based on the parent having the main rearing responsibility for the child. Immigrant status was defined as having at least one parent being born as a non-Swedish citizen.

A language problem was defined as one or more of: (a) speech delay according to parents or to child health centre records, or both—that is, 8–10 simple words only after the age of 18 months and intelligible sentences only after the age of 3 years; (b) receptive language dysfunction at the age of 6 years according to the child's preschool teacher; (c) limited vocabulary at the age of 6 years according to the preschool teacher; (d) dysarticulation present at assessment at the age of 6 years; and (e) a history of treatment by a speech therapist. A family history of a language problem was defined as speech delay, dyslexia, or other learning disorder in first degree relatives.

Certain other medical background factors were studied: infantile colic; a history of one or more middle ear infections; a history of one or more emergency room visits during the first six years; a history of, or current, allergy, asthma, or atopic dermatitis as defined in several

Table 3 Reduced optimality. Number (%) of subjects with particular background factor

	DAMP (n = 62)	Comparison (n = 51)	Odds ratio (CI)	p value
Social factors				
Ethnicity—immigrant	6 (10)	5 (10)	1.0 (0.2 to 4.4)	0.767
Family structure—divorced	19 (31)	8 (16)	2.4 (0.9 to 6.9)	0.102
Social class				
I	4 (7)	9 (18)		
II	12 (19)	22 (43)		
III	46 (74)	20 (39)	4.5 (1.9 to 10.7)	< 0.001
Mean (SD)	2.7 (0.6)	2.2 (0.7)		< 0.0001
*Familial reduced optimality factors**				
Speech/language retardation	8 (13)	1 (2)	7.7 (0.9 to 348.0)	0.037
Learning disorder	23 (38)	9 (18)	2.9 (1.1 to 8.0)	0.029
Motor clumsiness	20 (33)	6 (12)	3.8 (1.3 to 12.4)	0.014
Left handedness	16 (27)	15 (29)	0.9 (0.4 to 2.2)	0.913
Mental retardation or epilepsy	5 (8)	1 (2)	4.5 (0.5 to 215.3)	0.217
Tics	6 (10)	8 (16)	0.6 (0.2 to 2.1)	0.540
Attention deficit	10 (17)	3 (6)	3.2 (0.8 to 19.0)	0.137
Presence of one or more reduced optimality familial factors	49 (80)	31 (61)	2.6 (1.1 to 6.7)	0.038

*Two boys with DAMP were either living with foster parents or were adopted, and information about their family background was not obtained except one of the boys had a mother and brother with epilepsy.

previous studies from Skaraborg[21 22]; current sleep problems (restless sleep, snoring, obstructive sleep apnoea, and nightmares); and gastrointestinal symptoms (recurrent abdominal pain, constipation, nausea, and diarrhoea).

STATISTICAL ANALYSIS

For univariate analysis of the data, Stat View 4.02 (1992–3) and Epi Info 5.00 were used. Group frequency differences were analysed using the χ^2 test with Yates's correction or Fisher's exact test (two tailed) when numbers in individual cells were less than 5. The various mean scores and birth weights were compared using the Mann-Whitney U test. Logistic regression analysis was applied to the multivariate evaluation of the contribution of different background factors.

Results

SEX AND IQ

Subdivision according to sex has not been made in the tables. Comparison between girls and boys yielded significant differences for several variables and these are described in the text.

The IQ score tended to be lower in the DAMP than in the comparison group, although it was within the normal range in all instances. The complex relation between the diagnosis of DAMP, ADHD, and developmental coordination disorder (DCD) on the one hand, and IQ on the other is the subject of a separate report (Landgren *et al*, unpublished data). Briefly, it seems clear that although most children with these diagnoses have normal IQs and the diagnostic decision is not influenced by the child's IQ, about one third of children in the DAMP "spectrum" have borderline intellectual functioning and the assignment of a DAMP/ADHD/DCD diagnoses could be influenced by this fact. The general conclusions regarding background factors are, however, not affected by differential IQ effects.

SOCIAL AND FAMILIAL BACKGROUND FACTORS

Table 3 gives the social and familial background factors. More boys with DAMP than comparison cases were living in families containing half siblings (29 *v* 12%; odds ratio (OR) 3.1; 95% confidence interval (CI) 1.0 to 10.3; p = 0.045). There was no difference in the use of child care facilities or in the number of siblings. All neurodevelopmental familial factors were grouped together in a cluster and the combined mean score was significantly higher in the DAMP group (1.4) than in the comparison group (0.8) (p = 0.001). Familial language problems were strongly associated with DAMP in boys (OR 6.3; 95% CI 2.0 to 23.5; p = 0.001), but was not an important factor in girls.

PRENATAL FACTORS

Table 4 gives the possible prenatal factors. The mean collapsed score of prenatal risk factors was significantly higher in the DAMP group (0.85 *v* 0.29; p < 0.001). A total of 12 children (seven of 52 boys and five of 10 girls) with DAMP and two (both boys) in the comparison group had experienced major prenatal events that might have caused brain damage (preterm birth or pre-eclampsia) (p = 0.026). Six children with DAMP (two boys, four girls) and one boy in the comparison group had been born to mothers who had had pre-eclampsia. The difference was significant with regard to girls (p = 0.029). Smoking during pregnancy had occurred more often in children with DAMP (36 *v* 16% in the comparison group; OR 3.0; 95% CI 1.1 to 8.8; p = 0.027). Two mothers had taken antiepileptic drugs during pregnancy; both children (boys) were in the DAMP group. There was no indication of major alcohol exposure or severe infection in pregnancy in any of the groups.

The mean (SD) birth weight of the children with DAMP (3330 (740) g) was significantly lower than that in the comparison group (3650 (450) g) (p = 0.003). Five of the 62 children with DAMP (8%) and one of the 51 children in the comparison group (2%) had a birth weight less than 2500 g (NS) and 14 children with

Table 4 Number (%) of children in the DAMP and comparison groups with one or more possibly brain damaging factors

Risk factor	DAMP (n = 61)	Comparison (n = 51)	Odds ratio (CI)	p value
Prenatal	32 (53)	11 (22)	4.0 (1.6 to 10.2)	0.002
Intrapartum	14 (23)	4 (8)	3.5 (1.0 to 15.5)	0.039
Neonatal	9 (15)	3 (6)	2.8 (0.6 to 16.7)	0.219
Postnatal	7 (12)	3 (6)	2.1 (0.4 to 13.0)	0.342
Total	41 (67)	15 (29)	4.9 (2.1 to 12.0)	<0.001

Table 5 Number (%) of children with specific speech and language problems

Problem area	DAMP	Comparison	Odds ratio (CI)	p value
Child factors				
Speech delay	26 (42)	6 (12)	5.4 (1.9 to 17.6)	< 0.001
Present vocabulary*	8 (13)	2 (4)	3.7 (0.7 to 37.0)	0.108
Present word understanding*	3 (5)	0	–	0.249
Dysarticulation	31 (50)	3 (6)	16.0 (4.3 to 86.6)	< 0.001
Treatment by speech therapist	14 (23)	3 (6)	4.7 (1.2 to 26.6)	0.027
Any of above five factors	40 (65)	8 (16)	9.8 (3.6 to 27.9)	< 0.001
Mean (SD) number of factors	1.15 (1.1)	0.24 (0.6)		< 0.001
Familial factors				
Language disorder in family†	28 (47)	10 (20)	3.6 (1.4 to 9.5)	0.005
Child and familial factors				
Any speech or language problem	50 (83)	11 (28)	9.1 (3.6 to 23.8)	< 0.001

*Information about vocabulary and word understanding was missing for one boy with DAMP; †information about language disorder in family was missing for two boys, one adopted and one living with a foster family.

Table 6 Influence of various possible risk factors on the development of DAMP

Risk factor	p value	Relative risk (CI)
Motor clumsiness in family	0.025	3.8 (1.2 to 12.1)
Language disorder in family	0.06	2.6 (1.0 to 6.7)
Maternal smoking in pregnancy	0.10	2.5 (0.8 to 7.3)
(Low) birth weight	0.023	–
(Low) social class	0.002	4.5 (1.7 to 11.6)
Divorce	>0.30	1.0 (0.3 to 3.3)

A multivariate logistic regression model with relative risks, 95% confidence intervals, and p values. Information about familial factors and prenatal history was missing for two boys in the DAMP group, 60 children with DAMP and 51 comparison children are included in the model.

DAMP (23%) and four comparison children (8%) had a birth weight less than 3000 g ($p < 0.02$). Eight children with DAMP and two comparison children were born preterm. Two children with DAMP and one comparison child were born small for gestational age and four children with DAMP and one comparison child were born large for gestational age. The mean head circumference at birth did not differ across the groups.

INTRAPARTUM FACTORS

Table 4 gives the intrapartum factors. No child in this study had experienced major events that might have caused brain damage in the intrapartum period. The mean collapsed intrapartum score in the DAMP group (0.26) was significantly higher than that of the comparison group (0.10) ($p = 0.034$). This difference was due to the high proportion of girls with non-optimal intrapartum risk factors: six of 10 girls with DAMP had one or more intrapartum risk factors compared with none of the 12 girls in the comparison group ($p = 0.003$).

The only significant single factor was a lower Apgar score in girls with DAMP. Twelve children had Apgar scores < 9. Ten of these were in the DAMP group and five were girls. No girl in the comparison group had an Apgar score < 9 ($p = 0.010$). Four DAMP girls—all exposed to both smoking and maternal pre-eclampsia in pregnancy—and no comparison group girls were transferred to the neonatal ward. There was no significant difference with respect to twin births (three in total) or delivery with the help of vacuum extraction (four in total).

NEONATAL AND POSTNATAL FACTORS

Table 4 gives the possible neonatal and postnatal factors. A total of five children with DAMP and none in the comparison group had experienced either neonatal or postnatal major events that might have caused brain damage (septicaemia, hypoglycaemia or bacterial meningitis) ($p = 0.063$). The prevalence of non-optimal neonatal and postnatal factors was similar in the DAMP and comparison groups, but eight infants (13%) in the DAMP group had been admitted to the neonatal ward for observation or treatment compared with two (4%) in the comparison group (NS). None of the 113 children in the study had needed intubation, artificial ventilation, or had been regarded as critically ill. Four children in the DAMP group were treated with antibiotics for obvious or suspected septicaemia. One of these children also had hypoglycaemia and hyperbilirubinaemia; another had respiratory distress. A total of eight children (six with DAMP, two comparison) had hyperbilirubinaemia. One child in the comparison group was hypothermic at birth.

After the neonatal period, seven children in the DAMP group were admitted for central nervous system symptoms: one with bacterial meningitis; one with symptomatic hypoglycaemia with convulsions; three with mild concussion; and two with benign convulsions. In the comparison group one child had been admitted for aseptic meningitis and two for benign convulsions.

Table 7 Influence of various possible risk factors on the development of language problems

Risk factor	p value	Relative risk (CI)
Language disorder in family	0.002	4.0 (1.6 to 9.8)
Maternal smoking in pregnancy	0.034	3.0 (1.1 to 8.1)
(Low) birth weight	0.13	–
(Low) social class	>0.30	1.6 (0.6 to 3.9)
Divorce	0.17	2.2 (0.7 to 6.4)

A multivariate logistic regression model with relative risks, 95% confidence intervals, and p values. Information about familial factors and prenatal history was missing for two boys in the DAMP group, 60 children with DAMP and 51 comparison children are included in the model.

NEUROPATHOGENIC FACTORS

One or more neuropathogenic factors (prenatal, intrapartum, neonatal, and postnatal factors combined) occurred significantly more often in the DAMP group (table 4). A history of major brain damaging events was present in 16 children with DAMP (26%) compared with two in the comparison group (4%) ($p = 0.003$; OR 8.7; 95% CI 1.9 to 81.0). The collapsed score for reduced optimality in the prenatal, perinatal, and neonatal periods was significantly higher (1.4) in the DAMP than in the comparison group (0.5) ($p < 0.001$). This was most pronounced for the girls, of whom all 10 with DAMP had a history of one or more neuropathogenic risk factors compared with only one of the 12 comparison girls ($p < 0.001$). In the boys, 31 (61%) had one or more neuropathogenic factors compared with 14 (36%) in the comparison group ($p = 0.033$).

LANGUAGE FACTORS

Table 5 gives the language factors. In total, 65% of the DAMP and 16% of the comparison cases had (or had had) a language problem of some kind (OR 9.8; 95% CI 3.6 to 27.9; $p < 0.001$). A clear difference was found in respect of speech delay reported by the parents and verified by child health centre staff, or both, but only a few children with language problems had been detected on the basis of items reported by the preschool teachers (current vocabulary and receptive language).

UNIVARIATE ANALYSES

In univariate analyses, smoking during pregnancy was significantly associated with the occurrence of DAMP, a higher frequency of DSM-III-R ADHD symptoms, and language problems. The mean (SD) ADHD score was

Table 8 Ailments of interest studied

Ailment	*DAMP (n = 62)*	*Comparison (n = 51)*	*Odds ratio (CI)*	*p values*
Infantile colic	19 (31%)	15 (29%)	1.1 (0.4 to 2.6)	0.939
Atopy	21 (34%)	15 (29%)	1.2 (0.5 to 3.0)	0.762
Otitis media	17 (28%)	15 (29%)	0.9 (0.4 to 2.3)	0.976
Emergency visits	17 (27%)	11 (22%)	1.4 (0.5 to 3.7)	0.619
Sleep disorder	30 (48%)	12 (24%)	3.1 (1.3 to 7.6)	0.012
Gastrointestinal disorder	25 (40%)	8 (16%)	3.6 (1.4 to 10.4)	0.008

6.9 (3.9) in the smoking during pregnancy group and 4.8 (3.6) in the non-smoking during pregnancy group (p = 0.008).

MULTIVARIATE ANALYSIS

The association of smoking during pregnancy with DAMP and with language problems was also evaluated using logistic regression analysis (tables 6 and 7).

NON-NEUROLOGICAL SYMPTOMS/DISORDERS

Table 8 gives the non-neurological symptoms/disorders. The most common sleep problem in the DAMP group was marked nighttime snoring (31%). This occurred at a lower rate in the comparison group (14%) than in the DAMP group (OR 2.8; 95% CI 1.0 to 8.6; p < 0.057).

Discussion

This report is based on a population study of 6 year old children born in 1986–87 and living in a Swedish small town and rural setting. Similar screening and assessment methods have been used previously in a Swedish urban sample of 7 year old children. The results from that study agree well with the prevalence of DAMP and the occurrence of non-optimal background factors in our study.[3 12] The similar findings in an urban and a non-urban population support the data as representative of a Swedish population. As the DAMP diagnostic concept is shared across Scandinavia, there is reason to believe that it is also representative of other Nordic countries. These findings may also have relevance for children with DSM-III-R ADHD due to the considerable overlap between DAMP and ADHD.[4]

The IQ score tended to be lower in the group with DAMP. A study in progress by our group suggests that IQ may be a diagnostic confounder in the subgroup (about one third) of the children with DAMP with borderline intellectual functioning, but that even when IQ effects are partialled out, the overall results with regard to background factors in DAMP remain unaffected.

The socioeconomic distribution of the children in the comparison group is identical to a cross sectional sample of the general Swedish population (Swedish Central Bureau of Statistics 1992–93). The reason for the overrepresentation of social class III in DAMP and ADHD is unknown.[23] One possible contributory factor is non-optimal heredity. Children with DAMP often have parents who have (or once had) DAMP. DAMP and reading skills are associated with poor psychosocial adjustment.[10 24]

Learning disorders, language problems, or neurological/neurodevelopmental symptoms in first degree relatives and/or neuropathogenic factors in the child were present in more than 90% of the children with DAMP in both the Gothenburg and Skaraborg studies. Major brain damaging events had occurred in about one third of the children with DAMP. There is evidence for a cause–effect relation between hypoxic–haemodynamic brain injury in utero or neonatally and ADHD.[25] Our results add further support to this suggestion. Boys with DAMP tended towards a stronger familial load, whereas girls had a higher rate of potentially brain damaging factors.

Language problems, DAMP, and ADHD are known to run in families.[3 26–29] Children with DAMP develop reading problems at a high rate.[30 31] Speech delay is an important early prognostic sign for later reading disorders.[32 33] Early recognition and treatment of language problems seems to be important. It is therefore disappointing that most children with language problems had not been detected by the preschool teachers, in spite of the fact that their parents had often suspected that something was wrong in this respect in the child's first three years.

We found complete agreement between maternal recalled smoking data six to seven years after pregnancy and maternal health records. The validity of recalled smoking data has been reported to be about 90%.[34 35] Our finding of an association of DAMP and a higher rate of ADHD symptoms with maternal smoking during pregnancy agrees with other studies of ADHD and so called minimal brain dysfunction syndrome, a disorder similar to DAMP.[36–38]

Smoking covaries with many other factors, making a true association of DAMP and other developmental disorders difficult to establish. Our data from the regression analyses (tables 6 and 7) indicate an independent effect of maternal smoking during pregnancy on the development of DAMP or language disorder, or both. Exposure to maternal smoking during pregnancy may cause a range of neurobehavioural and neuropsychological deficits in children.[39–44] Reduced prostacyclin activity is induced by smoking and might well lead to a reduced capacity for sustaining fetal hypoxaemia. In rodents, experimental nicotine exposure during gestation affects later behaviour and causes a delay in neuronal maturation.[45–47] There is at least one possible alternative explanation for the association of smoking in pregnancy with DAMP, however, and that is genetic.[11] Smoking in pregnancy could be taken as a marker of a genetic trait for DAMP rather than an aetiological factor per se.

Common symptoms in a paediatric population such as infantile colic, otitis media, and atopy occurred at similar rates in the DAMP and comparison groups. Sleep and gastrointestinal disorders differentiated the groups from each other, however. The higher rate of snoring reported in the DAMP group (31 *v* 14%) might be due to neuromuscular disturbances. The rate of snoring in the comparison group was similar to that reported previously in 4–7 year old children.[48] The higher rate of gastrointestinal disorders recorded in the 6 year old

DAMP children could be due to attention deficits leading to the postponing of bowel movements, or deficient bowel motor control resulting in constipation and recurrent abdominal pain.

CONCLUSIONS

This study of background factors in DAMP showed a high rate of familial non-optimal symptoms and prenatal neuropathogenic factors. The impact of prenatal factors on the development of DAMP should not be a reason for passivity. Improved maternal health care, including the prevention of smoking during pregnancy, could lead to a reduction in the rate of language and behaviour problems and a reduction in DAMP in the general population. In any event, early detection and remediation of language problems, isolated or associated with DAMP/ADHD, are essential steps towards the prevention of psychosocially handicapping disorders that are otherwise often the result of untreated language disorders.[49 50]

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