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Early life exposures to home dampness, pet ownership and farm animal contact and neuropsychological development in 4 year old children: A prospective birth cohort study

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ABSTRACT

Exposure to biocontaminants is associated with behavioural problems and poorer cognitive function. Our study assesses the associations between early life exposure to home dampness, pets and farm animal contact and cognitive function and social competences in 4-year old children, and the associations between these indoor factors and microbial compounds (bacterial endotoxin and fungal extracellular polysaccharides). A Spanish population-based birth-cohort enrolled 482 children, and 424 of them underwent psychometric testing at 4 years of age, including the McCarthy Scales of Child Abilities (MSCA) and the California Preschool Social Competence Scale (CPSCS). Information on pet ownership, farm animal contact and home dampness was periodically reported by the parents through questionnaires. Microbial compounds were measured in living room sofa dust collected at the age of 3 months. Persistent home dampness during early life significantly decreased the general score of MSCA by 4.9 points (95% CI: −8.9; −0.8), and it decreased the CPSCS by 6.5 points (95% CI: −12.2; −0.9) in the child's bedroom. Cat or dog ownership were not associated with the outcomes, but occasional farm animal contact increased the general cognitive score of MSCA by 5.6 points (95% CI: 1.8; 9.3). Cat and dog ownership were associated with higher levels of endotoxins in home dust. None of the measured microbial compounds were related with the psychometric tests scores. In conclusion, damp housing in early life may have adverse effects on neuropsychological development at 4 years old. More research is needed to explore the possible involvement of mycotoxins in the observed results.

BACKGROUND

Brain development starts during pregnancy and is still continuing after puberty; therefore, the brain is particularly susceptible to any environmental insult during the first two decades of life, especially during early life (Grandjean and Landrigan, 2006). Several aspects related to home environment have been identified as risk factors for poor cognitive development in children. To date, most of the epidemiological studies focus on psychosocial factors related to family structure and functioning (Jenkins and Smith, 1991), illnesses (Barkmann et al., 2007), parental unemployment, and socio-economic status (Wille et al., 2008). Nevertheless, several indoor factors have shown to increase the risk of neuropsychological problems in children. For example, environmental tobacco smoke was associated with poor cognitive development at 4 years old (Julvez et al., 2007), and with higher risk of hyperactivity/inattention problems in school-age children (Julvez et al., 2007, Rückinger et al., 2010 and Tiesler et al., 2011). Also, indoor levels of nitrogen dioxide (NO_2) and gas appliances were suggested to have an adverse relation with cognition at the age of 4 (Sunyer et al., 2010 and Vrijheid et al., 2012).
In addition to these indoor factors, exposure to biocontaminants present indoors might be related to neuropsychological development. A Polish study suggests that persistent exposure to indoor mould during early life has a harmful effect on the cognitive development of the children at the age of 6 years (Jedrychowski et al., 2011). Moreover, a study performed in Germany observed an increased risk of behavioural problems at the age of 10 years in children exposed to visible mould, dampness and/or pet ownership (Casas et al., 2012).
In the present study, we aimed to assess the effects of living in damp homes, pet ownership, and farm animal contact during early life, on cognitive function and social competences at the age of 4 years in children participating in a Spanish birth cohort. Furthermore, we aimed to explore the association between the report of indoor dampness, pet ownership and farm animal contact and the bacterial endotoxin and fungal extracellular polysaccharides (EPS) levels in indoor dust.

METHODS

Study design and study population

Our study is based on a population-based birth cohort in Menorca Island, a Mediterranean island by the north-east coast of Spain. This cohort was established within the Asthma Multicenter Infant Cohort Study (Torrent et al., 2007), and it is part of the INMA – *INfancia y Medio Ambiente* [Environment and Childhood] project (Guxens et al., 2011). Pregnant women were enrolled during pregnancy at public primary health care centres or public hospitals in the island over a 12-month period starting in mid-1997. Children were followed from birth to the present. Written informed consent was obtained from all participants and the study was

approved by the Ethics Committees of the Institut Municipal d'Investigació Mèdica, Barcelona.
Interviewer-led questionnaires on socio-economic status, health, and environmental exposures, including information on pet ownership, farm animal contact, and dampness at home, were administered by trained research personal during pregnancy, and at the child ages of 3 months, and 1, 2 and 4 years. Living room sofa dust samples were collected at the age of 3 months and analysed for endotoxin and EPS. Neuropsychological testing of the children (McCarthy Scales of Children's Abilities (MSCA) and California Preschool Social Competence Scale (CPSCS)) was performed at four years of age.
Characteristics of the study population have been described elsewhere (Julvez et al., 2007). Briefly, 482 children (94% of those eligible) were enrolled and 424 (88% of them) provided neuropsychological data at the age of 4 years (422 for the MSCA, and 381 for the CPSCS). Children included in the study were not different from those not included regarding most population characteristics (maternal education, parental occupational category, sex of the child, location of the home, number of people living in the home, pet ownership, and dampness). However, participants had a higher percentage of report of farm animal contact during the first year of life (data not shown).

Cognitive development and social competence testing

Cognitive development was assessed at age 4 years using the Spanish version of the MSCA (McCarthy, 2009). The General Cognitive Scale was examined. A strict protocol was applied to avoid inter-observer variability, including inter-observer trainings and three sets of quality controls (inter-observer reliability-tests) undertaken during the fieldwork. The inter-observer variability was <5%.
Social competence was measured by teachers using the CPSCS (Julvez et al., 2008). This instrument is composed of 30 items, each item with four possible answers in a Likert scale (1–4). The items cover a wide range of behaviours such as response to routine, response to the unfamiliar, following instructions, making explanations, sharing, helping others, initiating activities, giving direction to activities, reaction to frustration, and accepting limits. The scale has been successfully adapted and validated into a bilingual version (Spanish/Catalan) to be used by both, monolingual and bilingual teachers (Julvez et al., 2011).
Continuous MSCA and CPSCSs were standardized to a mean score of 100 with a standard deviation of 15 to homogenize all the scales. The child's academic year was also collected during the visit.

Reported indoor factors: dampness, pet ownership and farm animal contact

Questions on the indoor factors assessed in the present study were taken from questionnaires administered to the parents from birth to the child's age of 4 years. Dampness in the child's bedroom, in the parent's bedroom, in the living room, and in any other room in the house was self-reported by the parents at the child's ages of 3 months, 1 and 2 years. With this information, we calculated 4 new variables, one for each of the three specific dampness locations (thus, excluding "any other rooms in the house"), and one for the whole home that included the information obtained for the 4 locations. Each new variable was composed of 3 categories: "never", "ever (<2 years)", and "persistent (2 years)". The "never" category included those individuals who never reported dampness in the target location, the "ever (<2 years)" category included those who reported dampness at least once in the target location but not in all the surveys, and the "persistent (2 years)" category included subjects with reported dampness in the target location in all three surveys. Moreover, we computed two additional variables to assess the possibility of a dose response effect: one included information on the number of times reporting dampness in each location (0–3 times), and the other, the number of locations with report of dampness (0–4 locations).

Cat and dog ownership information were assessed during pregnancy and at the child's ages of 2, 3 and 4 years, as 2 categories-variables: "no" and "yes". For the statistical analyses, we used the original variable of ownership during pregnancy (no/yes) and we computed two additional variables including the information collected during the first four years of life. The first was a dichotomized variable indicating "ever" exposed, that included all individuals that ever reported the ownership, versus "never" exposed. The second was a 3-category variable indicating "persistent" (over three surveys), "ever" (at least one report of ownership), and "never" exposed.

Information on farm animal contact was obtained from questions that included frequency of animal contact and age of first animal contact. For the study analyses, we computed 2 new variables, one including those individuals with first animal contact during the first year of life, categorized according to the frequency of contact (never/once a week or less/daily or more than once a week), and the other including animal contact at any age, also categorized according to the frequency of contact.

Assessment of indoor bacterial and fungal compounds: endotoxin and EPS

Living room sofa dust samples were collected at the age of 3 months. One square metre of each sofa was vacuumed during 180 s using a 1000 W vacuum cleaner with a cellulose filter by trained field workers. The samples had been extracted and analysed for mite allergens (Atkinson et al., 1999). The obtained dust was weighed and sieved with a 355 μm mesh sieve, extracted with BBS-Tween, and extracts were stored at −20 °C. Bacterial endotoxin and fungal EPS antigens were analysed in 2009–2010 in duplicate aliquots of the extracts by the Institute for Risk Assessment Sciences (IRAS, Utrecht, NL) with the Limulus Amebocyte Lysate test and a specific enzyme immunoassay as done in previous house dust analyses (Schram et al., 2005). Levels in extracts were measured in Endotoxin Units (EU) and EPS Units (EPSU) per mL, with as lower limits of detection (LOD) 2 EU/mL and 180 EPSU/mL, respectively, and converted to concentrations in the original dust (in EU/mg and EPSU/mg) and to the 'load' of microbial agents: in EU/m^2 and EPSU/m^2 of sampled surface.

Potential confounders

The questionnaire administered during pregnancy included parental socio-demographic data such as occupational history and education, lifestyle data of the biological parents, as well as medical data of the current pregnancy, maternal smoking during pregnancy, and housing conditions such as location (urban area, housing estate, or country house) and number of people living in the house. Occupational categories were obtained from the major group classification of the ISCO-88 (International Standard Classification of Occupations) of the longest held job by the mother and the father. In this study, parental occupational categories were the highest occupational category (paternal or maternal), and categorized in 4 groups:

high (categories I and II), medium non-manual (category III non-manual), medium manual (category III manual), and low (categories IV and V). For further sensitivity analyses, this variable was re-categorized in 2 groups: non-manual (I, II and III non-manual) and manual (III manual, V and IV). To obtain the maternal education variable, mothers were asked for the highest educational degree achieved. They were classified in 3 groups: primary school or less, secondary school, and university. Information on gestational age and duration of breast feeding was obtained at birth and at the age of 6 months, respectively. Information on child's health and parental report of indoor smoking was obtained yearly from the first year to the fourth. Finally, maternal intelligence was measured using the 2 and 3 scales of Factor “G” of Cattell and Cattell (1977) at the child's age of 11 years.

Statistical analysis

We used multivariable linear regression models to assess the associations between the parental report of dampness, pet ownership and farm animal contact and the cognitive function and social competences, and to assess the relationship between the mentioned indoor factors and the measured microbial compounds in dust (endotoxins and EPS). Potential confounders were a priori selected based on their relationship with neuropsychological development and the exposure variables in the literature. To assess the effects of the indoor factors on the neuropsychological outcomes, we included each exposure variable separately in the models. Afterwards, we computed a multiple adjusted model including all the exposure variables in order to assess the influence of the exposure variables on the associations observed. In order to assess the possibility of effect modification, we included interaction terms between pet ownership and dampness in the models.

When we assessed the relationship between the reported indoor factors and the measured microbial compounds (endotoxins and EPS) we only included samples with values ≥LOD. All samples had detectable levels of endotoxin, while EPS was undetectable in 11 samples. For the statistical analyses, we computed the units per mg of dust (U/mg). The distribution of concentrations of endotoxin and EPS was skewed to the right, and it was approximated normality after log-transformation. In order to facilitate interpretation, the resulting regression coefficients were back-transformed to their exponential (exp(β)), indicating the ratio of the geometric means of samples with and without the indoor factor under study. Moreover, we assessed the association between the measured microbial compounds and the neuropsychological outcomes using the same procedure explained for the indoor factors, coefficients obtained were transformed to β*ln(2), that indicates the association when the endotoxin or EPS levels are doubled. In addition, generalized additive models were used to assess a potential non-linear relationship between the endotoxin and EPS levels and the scores from the psychometric instruments. All statistical analyses were conducted with STATA SE 10.0 statistical software (Stata Corporation, College Station, TX, USA).

RESULTS

A description of the population socio-demographic characteristics and report of indoor factors, and the distribution of the scores in the general cognitive index (MSCA) and the global social competence scale (CPSCS) according to each factor are shown in Table 1. More than 60% of the study population ever reported having had dampness at home, and in approximately 20% of the population this report was persistent during 2 years. Approximately 40% and 20% reported ever having a dog and a cat, respectively, and 10% reported daily farm animal contact in the first year of life. General cognitive score and global social competence scores were lower in children reporting dampness and dog ownership, although these differences were only statistically significant ($p < 0.05$) for the global cognitive index and dog ownership. Moreover, a statistically significant crude association was observed between the general cognitive index and farm animal contact.

[TABLE 1.]

Adjusted associations between dampness, pet ownership and farm animal contact are shown in Table 2. After adjustment for potential confounders, persistent (2 years) exposure to dampness in the first 2 years of life was statistically significantly associated with decreases of 2–6 points in the general cognitive index score and decreases of 2–7 points in the global social competence scale, depending on the location of the dampness. These estimates were statistically significant for persistent dampness in any room of the house, and in the parents' room and the general cognitive index, and for persistent dampness in the child's bedroom and the global social competence scale. Additional adjustment for all the exposures did not alter the estimates obtained when introducing each exposure separately in the models. Furthermore, analyses per dampness location after excluding from the reference group those individuals with reported dampness in other locations did not significantly change the estimates (data not shown). Regarding pet ownership and farm animal contact, we did not observe any significant effect of the exposure to cat and dog ownership on both outcomes, meanwhile occasional farm animal contact was significantly associated with higher cognitive function scores. Adjusted associations for cat and dog ownership were also computed for the 3-categories variable that included a persistent ownership (data not shown) and results were not different from the ones shown in Table 2. Furthermore, the interaction terms between cat and dog ownership, and reported dampness where not statistically significant (p-value$\geq$0.05) (data not shown). The adjusted associations between the outcomes and the potential confounders included in the models are shown in the online Supplementary material (Table 1).

[TABLE 2.]

Regarding the indoor microbial compounds measurements, geometric mean of endotoxin and EPS levels in living room sofa dust at the age of 3 months was 3.1 EU/mg of dust and 116 EPSU/mg of dust, respectively. A description of the levels of measured indoor microbial compounds according to the indoor factors report, and the adjusted associations with each indoor factor are shown in Table 3. Endotoxin levels in living room sofa dust were higher in those homes with reported dampness, pet ownership and frequent animal contact, although the adjusted associations were only statistically significant for cat and dog ownership. In the case of EPS levels, no clear trend was observed for reported dampness, and geometric means were higher in homes with reported pet ownership. However, EPS levels were not significantly associated with any of the assessed indoor factors after adjustment. Similar estimates were obtained when using loads of microbial compounds (units per m^2) and when exploring the association between measured microbial compounds and dampness reported at 3 months of age (data not shown). Finally, no significant association was observed between the levels of the measured indoor microbial compounds at the age of 3 months and the neuropsychological outcomes: when doubling the endotoxin levels the general cognitive index decreased 0.1 points (95% confidence interval (CI): −0.7; 0.5) and the social competences scale also in 0.1 points (95% CI: −0.7; 0.5), regarding EPS, doubling the levels increased the general cognitive index in 0.8 points (95% CI: −0.5; 2.2) and the social competences scale in 1.3 points (95% CI: −0.1; 2.6). Additional analyses using generalized additive models showed a linear relationship between these variables and the outcomes (data not shown).

[TABLE 3]

DISCUSSION

Our findings suggest that persistent exposure to indoor dampness during early life has negative effects on the cognitive function and social competences at 4 years old. Pet ownership and frequent farm animal contact did not show any significant effect on neuropsychological development at that age. Nevertheless, our findings could not be confirmed by objective measurements of microbial agents during early life.
Experimental studies suggest that pre-natal and early life immune activation through the exposure to endotoxins can inhibit neurogenesis, and that this exposure during adulthood leads to immune-activation related mood disorders and cognitive disturbances (Cui et al., 2009, DellaGioia and Hannestad, 2010, Eisenberger et al., 2010, Reichenberg et al., 2001, Schwarz and Bilbo, 2011 and Yirmiya, 1996). Regarding the exposure to mycotoxins from mould, animal and human models showed an inflammatory and a neurotoxic effect (Corps et al., 2010, Doi and Uetsuka, 2011, Karunasena et al., 2010, Kihara et al., 2001, Kihara et al., 2000 and Pestka et al., 2008) that was potentiated by the co-exposure to endotoxins (Islam et al., 2007). However, caution needs to be exercised when comparing results in epidemiological studies with those from experimental studies, as the exposures assessed in experimental studies are much higher than the actual exposures that can be expected in indoor environments.
To date, only a few epidemiological studies assessed the effects of biocontaminant related indoor factors on the mental health. Most of them focussed on water-damaged buildings, and awarded a social explanation to the findings observed (Martin et al., 1987 and Platt et al., 1989). Nevertheless, the Large Analysis and Review of European housing and Health Status Study observed that dampness and mould in the house were associated with depression in adults after adjustment for several social-factors, and that this association was not mediated by physical illnesses (Shenassa et al., 2007).
Neuropsychological effects in children were assessed in two longitudinal studies, one on behavioural problems in children participating in a German birth cohort (Casas et al., 2012), and the other focusing on visible mould at home and cognitive development in Polish children (Jedrychowski et al., 2011). The German study observed an increased risk of behavioural problems at the age of 10 years in children exposed to visible mould, dampness and/or pet ownership. In addition, they found a strong interaction between pet ownership and dampness. The study by Jedrychowski et al. found an association between persistent early life exposure to indoor mould and a poorer cognitive function in children aged 6 years.

Our results are consistent with the findings on indoor mould exposure described above. Although we did not have information on the presence of mould in the home, dampness is highly correlated with the presence of mould and with an increase in the number of indoor mycotoxins detectable at elevated levels (Peitzsch et al., 2012). However, we did not have an objective measurement of indoor mycotoxins to support this hypothesis. In fact, the report of dampness in our study could not be validated by the objective measurements of indoor microbial agents and was not explained by the socio-economic characteristics of the study population (Supplementary material Table 2). We did not find a significant association between pet ownership and cognitive function and social competences or a significant interaction between dampness and pet ownership (data not shown). In addition, we found a positive effect of occasional farm animal contact on cognitive function and social competences in children, but no effect of daily farm animal contact.

The assessment and interpretation of the relationship between pet ownership and human health is complex (Eller et al., 2008, McNicholas et al., 2005 and Westgarth et al., 2010). Co-factors such as personality traits, age and economic or health status can impact on the decision to own a pet and on the type of pet chosen. Additionally, pet ownership may enhance social interactions, and provide emotional support, that would contribute to the family well being. Although some of these factors have been considered in our analyses, we cannot discard that the positive co-factors of pet ownership could compensate potentially negative effects on cognitive function. Consistently with these statements and with the no-effect observed for daily farm animal contact, we may speculate that the observed positive effects of occasional farm animal contact in our study could be an indirect indicator of a specific life style that stimulates the child's social and cognitive development since early life.

Despite the existing evidence that indoor microbial compounds are associated with pet ownership (Chen et al., 2012, Gehring et al., 2004 and Giovannangelo et al., 2007), dampness (Sordillo et al., 2011), and farm animal contact (Waser et al., 2004), we only found significant associations between endotoxin levels in living room dust and cat and dog ownership. The lack of significant associations in our study for dampness and farm animal contact may be due to the fact that home dust was only collected at the child's age of 3 months and the assessed indoor factors are representative of a 4 year period of time. However, dampness at the moment of the dust sampling was neither associated with the indoor levels of microbial compounds, suggesting that taking a single dust sample from sofa of a single home location may not always be representative of water damage, and that the presence of dampness indoors indicates something more than only the presence of microbial compounds. Moreover, the determination of fungal EPS antigens does not possess any species specific quality and thus does not allow to predict which *Aspergillus* and *Penicillium* species have contributed to the detected signal However, it can be assumed from previous studies that indoor species have indeed been detected (Chew et al., 2001 and Douwes et al., 1999). Consistently with the associations observed between the indoor microbial compounds and the indoor factors, we did not observe any significant association between the measured compounds and the studied neuropsychological outcomes.

In our longitudinal study, parent reported exposure data were collected in several consecutive surveys. Thus, we had repeated information on the presence or absence of each assessed indoor factor during the 4 years of follow-up. Moreover, in the case of dampness exposure, we had accurate information on the location in the house. This longitudinal design allowed us to have a very well defined group of never exposed to the indoor factors (high sensitivity; few false-negatives), and to take into account different time-periods for each exposure. Moreover, we considered a large number of potential confounders. Our results were independent of sex, age, acid folic intake during pregnancy, weeks of gestation, time of breast feeding, maternal education, maternal smoking, number of people living in the home, and location of the home.

However, information on socioeconomic status and specific housing conditions is important in the assessment of exposure to biological/microbial agents indoors. Family income, type of house, location of the house, ventilation characteristics, air conditioning or indoor smoking can be important determinants of the microbial exposures in the house, and some could also be associated with mental health. For example, mould and dampness may emerge preferably in less light exposed indoor environments, and sunlight deprivation is associated with depression (Brown and Jacobs, 2011). Although we did not have information on the type of house, the use of air conditioning, daily ventilation or the indoor light, we did have information on the type of area where the residence was (urban area, housing estate or country house), which we considered estimates of the general housing conditions, and thus included in the models. Moreover, exposure to indoor smoking is associated with cognitive function (Julvez et al., 2007). In our study, we included maternal smoking during pregnancy in the models, however, including post-natal exposure to environmental tobacco smoke did not modify our results.

Furthermore, when assessing cognitive function in children we need to consider potential residual confounding by parental intelligence, education and occupational categories. Also, low-income households are associated with inadequate housing conditions such as mould and dampness (Braubach and Fairburn, 2010). In our study, we did not have information on the maternal and paternal intelligence at the moment of the cognitive and social competences assessment, but we measured maternal intelligence at the child's age of 11 years. When we included this variable in the models, coefficients obtained were not different from the ones obtained previously. In addition, we had information on education and occupational categories of the parents. Cognitive and social competences tests scores were higher among the groups of parents with high education level and high occupational category. The adjusted associations shown in this study included adjustment for maternal education. Regarding the occupational category, we performed additional sensitivity analyses first adjusting and afterwards stratifying by occupational category, and we did not observe statistically significant differences between the coefficients obtained without adjustment and, in the stratification, in each group. Moreover, no statistically significant associations were observed between the report of dampness and maternal education and occupational category (Supplementary material Table 2). This lack of association may be due to the high humidity characteristics of the Menorca climate.

In conclusion, the persistent exposure to indoor dampness during early life can have a negative effect on cognitive function and social competences at the age of 4 years. This association is consistent with the results observed in previous epidemiological studies and strengthened by the longitudinal design of our study. However, information on dampness in our study was based on subjective report and could not be objectivized. This is thus a limitation that should be considered when interpreting the results. Indoor dampness can be considered as a potential indicator of indoor mould, generally elevated microbial growth and production of microbial secondary metabolites, including mycotoxins. However, these results could not be confirmed by objective measurements of microbial agents in home dust. More research is needed to explore the possible involvement of neurotoxic mycotoxins in impaired neuropsychological development observed in damp buildings. Other potential sources of microbial exposure such as pet ownership or farm animal contact did not show a statistically significant negative effect on neuropsychological development at the age of 4 years.

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REFERENCES

1. Atkinson et al., 1999W. Atkinson, J. Harris, P. Mills, S. Moffat, C. White, O. Lynch, M. Jones, P. Cullinan, A.J. Newman TaylorDomestic aeroallergen exposures among infants in an English townEur. Respir. J., 13 (1999), pp. 583–589
2. Barkmann et al., 2007C. Barkmann, G. Romer, M. Watson, M. Schulte-MarkwortParental physical illness as a risk for psychosocial maladjustment in children and adolescents: epidemiological findings from a national survey in GermanyPsychosomatics, 48 (2007), pp. 476–481
3. Braubach and Fairburn, 2010M. Braubach, J. FairburnSocial inequities in environmental risks associated with housing and residential location – a review of evidenceEur. J. Public Health, 20 (2010), pp. 36–42
4. Brown and Jacobs, 2011M.J. Brown, D.E. JacobsResidential light and risk for depression and falls: results from the LARES study of eight European citiesPublic Health Rep., 126 (Suppl. 1) (2011), pp. 131–140
5. Casas et al., 2012L. Casas, C. Tiesler, E. Thiering, I. Brüske, S. Koletzko, C.-P. Bauer, H.-E. Wichmann, A. Von Berg, D. Berdel, U. Krämer, B. Schaaf, I. Lehmann, O. Herbarth, J. Sunyer, J. HeinrichIndoor factors and behavioural problems in children: the GINIplus and LISAplus birth cohort studiesInt. J. Hyg. Environ. Health (2012)
6. Cattell and Cattell, 1977Cattell, R., Cattell, A., 1977. Manual de Factor "g". Escalas 2 y 3. Ediciones TEA.
7. Corps et al., 2010K.N. Corps, Z. Islam, J.J. Pestka, J.R. HarkemaNeurotoxic, inflammatory, and mucosecretory responses in the nasal airways of mice repeatedly exposed to the macrocyclic trichothecene mycotoxin roridin A: dose–response and persistence of injuryToxicol. Pathol., 38 (2010), pp. 429–451

8. Cui et al., 2009K. Cui, H. Ashdown, G.N. Luheshi, P. BoksaEffects of prenatal immune activation on hippocampal neurogenesis in the ratSchizophr. Res., 113 (2009), pp. 288–297
9. Chen et al., 2012C.-M. Chen, E. Thiering, G. Doekes, J.-P. Zock, I. Bakolis, D. Norbäck, J. Sunyer, S. Villani, G. Verlato, M. Täubel, D. Jarvis, J. HeinrichGeographical variation and the determinants of domestic endotoxin levels in mattress dust in EuropeIndoor Air, 22 (2012), pp. 24–32
10. Chew et al., 2001G.L. Chew, J. Douwes, G. Doekes, K.M. Higgins, R. Van Strien, J. Spithoven, B. BrunekreefFungal extracellular polysaccharides, beta (1 → 3)-glucans and culturable fungi in repeated sampling of house dustIndoor Air, 11 (2001), pp. 171–178
11. DellaGioia and Hannestad, 2010N. DellaGioia, J. HannestadA critical review of human endotoxin administration as an experimental paradigm of depressionNeurosci. Biobehav. Rev., 34 (2010), pp. 130–143
12. Doi and Uetsuka, 2011K. Doi, K. UetsukaMechanisms of mycotoxin-induced neurotoxicity through oxidative stress-associated pathwaysInt. J. Mol. Sci., 12 (2011), pp. 5213–5237View Record in Scopus|
13. Douwes et al., 1999J. Douwes, B. Van der Sluis, G. Doekes, F. Van Leusden, L. Wijnands, R. Van Strien, A. Verhoeff, B. BrunekreefFungal extracellular polysaccharides in house dust as a marker for exposure to fungi: relations with culturable fungi, reported home dampness, and respiratory symptomsJ. Allergy Clin. Immunol., 103 (1999), pp. 494–500
14. Eisenberger et al., 2010N.I. Eisenberger, E.T. Berkman, T.K. Inagaki, L.T. Rameson, N.M. Mashal, M.R. IrwinInflammation-induced anhedonia: endotoxin reduces ventral striatum responses to rewardBiol. Psychiatry, 68 (2010), pp. 748–754
15. Eller et al., 2008E. Eller, S. Roll, C.-M. Chen, O. Herbarth, H.-E. Wichmann, A. Von Berg, U. Krämer, M. Mommers, C. Thijs, A. Wijga, B. Brunekreef, M.P. Fantini, F. Bravi, F. Forastiere, D. Porta, J. Sunyer, M. Torrent, A. Høst, S. Halken, K.C. Lødrup Carlsen, K.-H. Carlsen, M. Wickman, I. Kull, U. Wahn, S.N. Willich, S. Lau, T. Keil, J. HeinrichMeta-analysis of determinants for pet ownership in 12 European birth cohorts on asthma and allergies: a GA2LEN initiativeAllergy, 63 (2008), pp. 1491–1498
16. Gehring et al., 2004U. Gehring, W. Bischof, M. Borte, O. Herbarth, H.-E. Wichmann, J. HeinrichLevels and predictors of endotoxin in mattress dust samples from East and West German homesIndoor Air, 14 (2004), pp. 284–292
17. Giovannangelo et al., 2007M. Giovannangelo, U. Gehring, E. Nordling, M. Oldenwening, G. Terpstra, T. Bellander, G. Hoek, J. Heinrich, B. BrunekreefDeterminants of house dust endotoxin in three European countries – the AIRALLERG studyIndoor Air, 17 (2007), pp. 70–79 |
18. Grandjean and Landrigan, 2006P. Grandjean, P.J. LandriganDevelopmental neurotoxicity of industrial chemicalsLancet, 368 (2006), pp. 2167–2178
19. Guxens et al., 2011M. Guxens, F. Ballester, M. Espada, M.F. Fernández, J.O. Grimalt, J. Ibarluzea, N. Olea, M. Rebagliato, A. Tardón, M. Torrent, J. Vioque, M. Vrijheid, J. Sunyer
20. Cohort profile: the INMA – INfancia y Medio Ambiente – (Environment and Childhood) ProjectInt. J. Epidemiol. (2011)
21. Islam et al., 2007Z. Islam, C.J. Amuzie, J.R. Harkema, J.J. PestkaNeurotoxicity and inflammation in the nasal airways of mice exposed to the macrocyclic trichothecene mycotoxin roridin a: kinetics and potentiation by bacterial lipopolysaccharide coexposureToxicol. Sci., 98 (2007), pp. 526–541
22. Jedrychowski et al., 2011W. Jedrychowski, U. Maugeri, F. Perera, L. Stigter, J. Jankowski, M. Butscher, E. Mroz, E. Flak, A. Skarupa, A. SowaCognitive function of 6-year old children exposed to mold-contaminated homes in early postnatal period. Prospective birth cohort study in PolandPhysiol. Behav., 104 (2011), pp. 989–995
23. Jenkins and Smith, 1991J.M. Jenkins, M.A. SmithMarital disharmony and children's behaviour problems: aspects of a poor marriage that affect children adverselyJ. Child Psychol. Psychiatry, 32 (1991), pp. 793–810

24. Julvez et al., 2008J. Julvez, M. Forns, N. Ribas-Fitó, C. Mazón, M. Torrent, R. Garcia-Esteban, L. Ellison-Loschmann, J. SunyerPsychometric characteristics of the California preschool social competence scale in a Spanish population sampleEarly Educ. Dev., 19 (2008), pp. 795–815|
25. Julvez et al., 2011J. Julvez, M. Forns, N. Ribas-Fitó, M. Torrent, J. SunyerAttention behavior and hyperactivity and concurrent neurocognitive and social competence functioning in 4-year-olds from two population-based birth cohortsEur. Psychiatry, 26 (2011), pp. 381–389
26. Julvez et al., 2007J. Julvez, N. Ribas-Fitó, M. Torrent, M. Forns, R. Garcia-Esteban, J. SunyerMaternal smoking habits and cognitive development of children at age 4 years in a population-based birth cohortInt. J. Epidemiol., 36 (2007), pp. 825–832
27. Karunasena et al., 2010E. Karunasena, M.D. Larrañaga, J.S. Simoni, D.R. Douglas, D.C. StrausBuilding-associated neurological damage modeled in human cells: a mechanism of neurotoxic effects by exposure to mycotoxins in the indoor environmentMycopathologia, 170 (2010), pp. 377–390
28. Kihara et al., 2000T. Kihara, T. Matsuo, M. Sakamoto, Y. Yasuda, Y. Yamamoto, T. TanimuraEffects of prenatal aflatoxin B1 exposure on behaviors of rat offspringToxicol. Sci., 53 (2000), pp. 392–399
29. Kihara et al., 2001T. Kihara, T.W. Surjono, M. Sakamoto, T. Matsuo, Y. Yasuda, T. TanimuraEffects of prenatal rubratoxin-B exposure on behaviors of mouse offspringToxicol. Sci., 61 (2001), pp. 368–373
30. Martin et al., 1987C.J. Martin, S.D. Platt, S.M. HuntHousing conditions and ill healthBr. Med. J. (Clin. Res. Ed.), 294 (1987), pp. 1125–1127
31. McCarthy, 2009D. McCarthyMSCA. Escalas McCarthy de Aptitudes y Psicomotricidad para NñosEdiciones TEA, Madrid (2009)
32. McNicholas et al., 2005J. McNicholas, A. Gilbey, A. Rennie, S. Ahmedzai, J.-A. Dono, E. OrmerodPet ownership and human health: a brief review of evidence and issuesBMJ, 331 (2005), pp. 1252–1254
33. | Peitzsch et al., 2012M. Peitzsch, M. Sulyok, M. Täubel, V. Vishwanath, E. Krop, A. Borràs-Santos, A. Hyvärinen, A. Nevalainen, R. Krska, L. LarssonMicrobial secondary metabolites in school buildings inspected for moisture damage in Finland, The Netherlands and SpainJ. Environ. Monit., 14 (2012), pp. 2044–2053
34. Pestka et al., 2008J.J. Pestka, I. Yike, D.G. Dearborn, M.D.W. Ward, J.R. HarkemaStachybotrys chartarum, trichothecene mycotoxins, and damp building-related illness: new insights into a public health enigmaToxicol. Sci., 104 (2008), pp. 4–26
35. Platt et al., 1989S.D. Platt, C.J. Martin, S.M. Hunt, C.W. LewisDamp housing, mould growth, and symptomatic health stateBMJ, 298 (1989), pp. 1673–1678
36. View Record in Scopus
37. | Reichenberg et al., 2001A. Reichenberg, R. Yirmiya, A. Schuld, T. Kraus, M. Haack, A. Morag, T. PollmächerCytokine-associated emotional and cognitive disturbances in humansArch. Gen. Psychiatry, 58 (2001), pp. 445–452
38. Rückinger et al., 2010S. Rückinger, P. Rzehak, C.-M. Chen, S. Sausenthaler, S. Koletzko, C.-P. Bauer, U. Hoffmann, U. Kramer, D. Berdel, A. Von Berg, O. Bayer, H.-E. Wichmann, R. Von Kries, J. HeinrichPrenatal and postnatal tobacco exposure and behavioral problems in 10-year-old children: results from the GINI-plus prospective birth cohort studyEnviron. Health Perspect., 118 (2010), pp. 150–154 |
39. Schram et al., 2005D. Schram, G. Doekes, M. Boeve, J. Douwes, J. Riedler, E. Ublagger, E. Von Mutius, J. Budde, G. Pershagen, F. Nyberg, J. Alm, C. Braun-Fahrländer, M. Waser, B. BrunekreefBacterial and fungal components in house dust of farm children. Rudolf Steiner school children and reference children – the PARSIFAL studyAllergy, 60 (2005), pp. 611–618
40. Schwarz and Bilbo, 2011J.M. Schwarz, S.D. BilboLPS elicits a much larger and broader inflammatory response than *Escherichia coli* infection within the hippocampus of neonatal ratsNeurosci. Lett., 497 (2011), pp. 110–115
41. Shenassa et al., 2007E.D. Shenassa, C. Daskalakis, A. Liebhaber, M. Braubach, M. BrownDampness and mold in the home and depression: an examination of mold-

related illness and perceived control of one's home as possible depression pathwaysAm. J. Public Health, 97 (2007), pp. 1893–1899
42. Sordillo et al., 2011J.E. Sordillo, U.K. Alwis, E. Hoffman, D.R. Gold, D.K. MiltonHome characteristics as predictors of bacterial and fungal microbial biomarkers in house dustEnviron. Health Perspect., 119 (2011), pp. 189–195
43. Sunyer et al., 2010J. Sunyer, X. Basagaña, J.R. González, J. Júlvez, S. Guerra, M. Bustamante, R. De Cid, J.M. Antó, M. TorrentEarly life environment, neurodevelopment and the interrelation with atopyEnviron. Res., 110 (2010), pp. 733–738
44. Tiesler et al., 2011C.M.T. Tiesler, C.-M. Chen, S. Sausenthaler, O. Herbarth, I. Lehmann, B. Schaaf, U. Krämer, A. Von Berg, R. Von Kries, H.-E. Wichmann, J. HeinrichPassive smoking and behavioural problems in children: results from the LISAplus prospective birth cohort studyEnviron. Res., 111 (2011), pp. 1173–1179
45. Torrent et al., 2007M. Torrent, J. Sunyer, R. Garcia, J. Harris, M.V. Iturriaga, C. Puig, O. Vall, J.M. Anto, A.J. Newman Taylor, P. CullinanEarly-life allergen exposure and atopy, asthma, and wheeze up to 6 years of ageAm. J. Respir. Crit. Care Med., 176 (2007), pp. 446–453
46. Vrijheid et al., 2012M. Vrijheid, D. Martinez, I. Aguilera, M. Bustamante, F. Ballester, M. Estarlich, A. Fernandez-Somoano, M. Guxens, N. Lertxundi, M.D. Martinez, A. Tardon, J. SunyerIndoor air pollution from gas cooking and infant neurodevelopmentEpidemiology (Cambridge, Mass.), 23 (2012), pp. 23–32
47. Waser et al., 2004M. Waser, R. Schierl, E. Von Mutius, S. Maisch, D. Carr, J. Riedler, W. Eder, M. Schreuer, D. Nowak, C. Braun-FahrländerDeterminants of endotoxin levels in living environments of farmers’ children and their peers from rural areasClin. Exp. Allergy, 34 (2004), pp. 389–397
48. Westgarth et al., 2010C. Westgarth, J. Heron, A.R. Ness, P. Bundred, R.M. Gaskell, K.P. Coyne, A.J. German, S. McCune, S. DawsonFamily pet ownership during childhood: findings from a UK birth cohort and implications for public health researchInt. J. Environ. Res. Public Health, 7 (2010), pp. 3704–3729
49. Wille et al., 2008N. Wille, S. Bettge, U. Ravens-SiebererRisk and protective factors for children's and adolescents’ mental health: results of the BELLA studyEur. Child Adolesc. Psychiatry, 17 (Suppl. 1) (2008), pp. 133–147
50. Yirmiya, 1996R. YirmiyaEndotoxin produces a depressive-like episode in ratsBrain Res., 711 (1996), pp. 163–174

TABLES AND FIGURES

Table 1.

Description of the population characteristics, indoor factors, and the standardized results of the McCarthy Scales of Children's Abilities (MSCA) and the California Preschool Social Competence Scale (CPSCS) tests.

	Total	**MSCA**	**CPSCS**
		General cognitive index	**Global social competence scale**
	***n* = 424**	***n* = 422**	***n* = 381**
	***n* (%)**	**Mean (sd)**	**Mean (sd)**
Parental occupational class			
High (I - II)	99 (23.5)	103.2 (14.0)	102.9 (14.5)
Medium non-manual (III	139	101.2 (15.3)	101.8 (14.7)

	Total	MSCA	CPSCS
		General cognitive index	Global social competence scale
	n = 424	*n* = 422	*n* = 381
	n (%)	Mean (sd)	Mean (sd)
non manual)	(32.9)		
Medium manual (III manual)	154 (36.5)	97.2 (15.3)	97.3 (15.0)
Low (IV–V)	30 (7.1)	98.2 (13.7)*	97.3 (15.9)*
Maternal education			
University	58 (14.2)	104.7 (15.2)	102.1 (13.5)
Secondary	113 (27.7)	100.9 (16.3)	103.9 (14.5)
Primary or less	237 (58.1)	98.3 (14.2)*	97.9 (15.2)*
Dampness at home in the first 2 years of life			
Never	160 (38.7)	100.9 (15.9)	99.5 (15.4)
Ever	174 (42.0)	100.7 (15.1)	101.8 (14.5)
Persistent	80 (19.3)	97.0 (12.8)	97.6 (15.2)
Dampness in the child's room in the first 2 years of life			
Never	305 (74.6)	99.8 (15.5)	100.1 (14.8)
Ever	77 (18.8)	102.3 (14.4)	102.1 (14.5)
Persistent	27 (6.6)	97.0 (11.4)	95.5 (16.4)
Dampness in the parent's room in the first 2 years of life			
Never	242 (58.2)	100.9 (15.6)	100.4 (14.7)
Ever	135 (32.5)	99.5 (14.3)	101.2 (14.3)
Persistent	39 (9.4)	96.0 (14.0)	96.0 (16.5)
Dampness in the living room in the first 2 years of life			
Never	325 (77.9)	100.2 (15.5)	100.9 (14.5)
Ever	75 (18.0)	100.1 (14.1)	99.1 (15.7)

	Total	MSCA	CPSCS
		General cognitive index	Global social competence scale
	n = 424	*n* = 422	*n* = 381
	n (%)	Mean (sd)	Mean (sd)
Persistent	17 (4.1)	96.7 (8.7)	93.0 (16.8)
Cat ownership during pregnancy			
No	366 (86.7)	99.9 (15.1)	100.1 (15.4)
Yes	56 (13.3)	100.5 (14.4)	99.2 (12)
Cat ownership from pregnancy to 4 years old			
Never	333 (78.9)	99.8 (15.2)	99.9 (15.7)
Ever	77 (18.3)	100.4 (13.6)	100.5 (12.8)
Persistent ownership from pregnancy to 4 years	12 (2.8)	99.9 (18.1)	99.0 (9.9)
Dog ownership during pregnancy			
No	278 (66)	101.2 (15.0)	101.0 (14.9)
Yes	143 (34)	97.5 (14.9)*	98 (15.3)
Dog ownership from pregnancy to 4 years old			
Never	242 (57.5)	101.3 (15.0)	101.0 (14.8)
Ever	126 (29.9)	97.2 (15.3)	98.6 (15.9)
Persistent ownership from pregnancy to 4 years	53 (12.6)	100.4 (13.6)*	98.4 (14.2)
Contact with farm animals in the first year of life			
Never	311 (73.4)	99.2 (15.0)	99.4 (15.1)
Once a week or less	70 (16.5)	104.4 (15.3)	102.0 (15.2)
Daily or more than once a week	43 (10.1)	98.5 (13.0)*	101.0 (13.7)
Contact with farm animals in the first 4 years of life			
Never	297 (70.1)	99.1 (14.6)	99.4 (15.1)

	Total	**MSCA**	**CPSCS**
		General cognitive index	**Global social competence scale**
	n **= 424**	***n*** **= 422**	***n*** **= 381**
	n **(%)**	**Mean (sd)**	**Mean (sd)**
Once a week or less	79 (18.6)	104.3 (16.7)	102.0 (15.4)
Daily or more than once a week	48 (11.3)	98.2 (13.4)*	100.0 (13.8)

*

p-value < 0.05.

Table 2.

Adjusted associations between reported dampness, cat and dog ownership, and farm animal contact during early life, and the scores of the general cognitive index in the McCarthy Scales of Children's Abilities (MSCA), and the global social competence scale in the California Preschool Social Competence Scale (CPSCS).

	MSCA			**CPSCS**		
	General cognitive index, *n* = 422			**Global social competence scale, *n* = 381**		
	β [a]	**(95% CI)**	***p*-value**	***β*** [a]	**(95% CI)**	***p*-value**
Dampness at home in the first 2 years of life						
Ever	−0.50	(−3.78; 2.78)	0.764	2.59	(−0.65; 5.83)	0.117
Persistent	−4.85	(−8.94; −0.77)	0.020	−2.07	(−6.15; 2.01)	0.319
Dampness in the child's room in the first 2 years of life						
Ever	2.42	(−1.32; 6.17)	0.204	1.68	(−2.04; 5.41)	0.374
Persistent	−3.20	(−9.04; 2.64)	0.282	−6.54	(−12.19; −0.89)	0.023
Dampness in the parent's room in the first 2 years of life						
Ever	−0.62	(−3.83; 2.6)	0.705	1.74	(−1.44; 4.92)	0.282
Persistent	−6.28	(−11.36; −1.19)	0.016	−3.89	(−8.77; 0.98)	0.117
Dampness in the living room in the first 2 years of life						
Ever	−0.13	(−3.95; 3.69)	0.945	−1.24	(−4.99; 2.51)	0.516
Persistent	−2.48	(−10.04; 5.08)	0.519	−4.81	(−12.68; 3.07)	0.231
Cat ownership at birth	0.49	(−3.94; 4.91)	0.829	0.79	(−3.76; 5.34)	0.734
Dog ownership at birth	−3.06	(−6.51; 0.4)	0.083	−0.30	(−3.71; 3.12)	0.865
Contact with farm animals in the first year of life						
Once a week or less	5.57	(1.8; 9.33)	0.004	3.66	(−0.05; 7.37)	0.053
Daily or more than	−1.62	(−6.31;	0.498	0.43	(−4.15; 5)	0.855

	MSCA			**CPSCS**		
	General cognitive index, *n* = 422			**Global social competence scale, *n* = 381**		
	β [a]	**(95% CI)**	***p*-value**	**β [a]**	**(95% CI)**	***p*-value**
once a week		3.07)				

Table 3.

Description (geometric mean (GM) and 95% confidence interval (CI)) of endotoxin and EPS levels in living room sofa dust at the child's age of 3 months, according to the reported dampness at home, pet ownership at birth, and farm animal contact, and the adjusted associations (GM ratio and 95% CI), excluding samples with values below the LOD.

	Endotoxin levels in living room sofa (EU/mg)					**EPS levels in living room sofa (U/mg)**				
	n	**GM**	**95% CI**	**GM ratio[a]**	**95% CI**	***n***	**GM**	**95% CI**	**GM ratio[a]**	**95% CI**
Total	401	3.1	(2.6; 3.8)	–	–	384	116.2	(106.8; 126.4)	–	–
Dampness at home in the first 2 years of life										
Never	153	2.9	(2.1; 3.9)	1		147	104.7	(92.3; 118.7)	1	
Ever	164	3.4	(2.5; 4.5)	0.9	(0.6; 1.3)	156	121.2	(106.1; 138.5)	1.1	(0.9; 1.4)
Persistent	78	3.1	(2.1; 4.6)	0.8	(0.5; 1.4)	75	132.0	(105.9; 164.7)	1.1	(0.9; 1.4)
Dampness in the child's room in the first 2 years of life										
Never	291	3.0	(2.4; 3.7)	1		282	115.0	(105.1; 125.9)	1	
Ever	76	3.4	(2.3; 5.1)	1.1	(0.7; 1.7)	72	125.9	(98.5; 160.9)	1.1	(0.9; 1.4)
Persistent	26	3.3	(1.6; 7.1)	0.8	(0.4; 1.7)	23	105.4	(69.1; 160.7)	0.8	(0.6; 1.1)
Dampness in the parent's room in the first 2 years of life										
Never	233	2.9	(2.3; 3.7)	1		226	115.3	(102.7; 129.3)	1	

	Endotoxin levels in living room sofa (EU/mg)					EPS levels in living room sofa (U/mg)				
	n	GM	95% CI	GM ratio[a]	95% CI	*n*	GM	95% CI	GM ratio[a]	95% CI
Ever	127	3.4	(2.5; 4.7)	1.1	(0.7; 1.6)	120	117.3	(102.2; 134.8)	1.0	(0.8; 1.2)
Persistent	38	3.2	(1.6; 6.2)	0.9	(0.5; 1.6)	35	113.9	(85.1; 152.3)	0.9	(0.7; 1.2)
Dampness in the living room in the first 2 years of life										
Never	313	3.2	(2.6; 3.9)	1		300	117.8	(107.1; 129.6)	1	
Ever	71	2.9	(1.9; 4.5)	0.8	(0.5; 1.2)	68	103.9	(85.9; 125.6)	0.9	(0.7; 1.1)
Persistent	17	3.0	(1.3; 7.1)	0.6	(0.2; 1.5)	16	144.5	(83; 251.6)	1.1	(0.7; 1.7)
Cat ownership at birth										
No	385	2.9	(2.3; 3.4)	1		371	115.9	(105.6; 126.4)	1	
Yes	66	7.0	(3.8; 10.0)	1.7	(1.0; 2.8)	64	131.4	(93.8; 153.3)	0.9	(0.7; 1.1)
Dog ownership at birth										
No	291	2.6	(2.0; 3.2)	1		280	113.4	(101.8; 123.1)	1	
Yes	159	4.9	(3.4; 6.3)	1.5	(1.0; 2.3)	154	127.3	(105.4; 147.3)	1.0	(0.8; 1.2)
Contact with farm animals in the first year of life										
Never	324	3.0	(2.3; 3.6)	1		312	115.4	(103.4; 126.1)	1	
Once a week or less	80	3.5	(2.3; 5.3)	1.1	(0.7; 1.8)	77	106.1	(85.5; 132.7)	0.9	(0.7; 1.1)
Daily or more than once a week	49	5.2	(2.7; 7.2)	1.4	(0.8; 2.4)	48	159.6	(120.4; 184.8)	1.2	(0.9; 1.5)

a

Estimates adjusted for location, season of dust sampling and maternal education.

SUPPLEMENTARY MATERIAL

Table 1. Adjusted associations between the assessed potential confounders and the scores of the General Cognitive Index in the McCarthy Scales of Children's Abilities (MSCA), and the Global Social Competence scale in the California Preschool Social Competence Scale (CPSCS).

	MSCA				CPSCS			
		95% CI				95% CI		
	β	lower	upper	p-value	β	lower	upper	p-value
Age at the moment of the test administration (years)	3.72	-7.95	15.40	0.531	0.67	-5.21	6.54	0.823
Psychologist	4.92	1.25	8.58	0.009	-	-	-	-
Sex (ref: girl)	-1.84	-4.73	1.06	0.213	-6.62	-9.55	-3.69	<0.001
Weeks of breast feeding	0.06	-0.02	0.15	0.136	0.10	0.01	0.18	0.022
Folic acid intake	3.52	0.56	6.48	0.020	4.15	1.14	7.16	0.007
Weeks of gestation	0.62	-0.23	1.46	0.155	-	-	-	-
Maternal education (ref: primary or lower)								
Secondary	1.59	-1.83	5.00	0.361	4.25	0.86	7.64	0.014
University	5.54	1.32	9.77	0.010	3.79	-0.65	8.23	0.094
Number of people living in the home (ref: three or less)								
Four	-2.51	-5.73	0.71	0.126	-5.85	-9.10	-2.60	<0.001
Five or more	-5.88	-10.03	-1.72	0.006	-7.18	-11.57	-2.79	0.001
Location (ref: urban area)								
Suburbs	-1.23	-5.33	2.88	0.557	-0.25	-4.19	3.68	0.900
Rural areas	-2.65	-7.47	2.17	0.280	-1.19	-6.21	3.82	0.640
Maternal indoor smoking	1.32	-1.77	4.40	0.402	-	-	-	-

Table 2. Description of socio-economic status (parental occupational class and maternal education) according to the report of dampness at home in the first two years of life.

	Dampness at home in the first two years of life			
	Never n (%)	Ever n (%)	Persistent n (%)	p-value
Parental occupational category				
High (I - II)	33 (20.75)	45 (25.86)	19 (24.05)	
Medium non-manual (III non manual)	59 (37.11)	55 (31.61)	21 (26.58)	
Medium manual (III manual)	57 (35.85)	59 (33.91)	35 (44.3)	
Low (IV - V)	10 (6.29)	15 (8.62)	4 (5.06)	0.461
Maternal education				
Primary or less	92 (58.97)	89 (53.61)	50 (65.79)	
Secondary	44 (28.21)	53 (31.93)	13 (17.11)	
University	20 (12.82)	24 (14.46)	13 (17.11)	0.185