**BIOGRAPHICAL SKETCH**

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NAME: Bornehag, Carl-Gustaf

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Professor in Public Health Sciences

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

| INSTITUTION AND LOCATION | DEGREE *(if applicable)* | Completion Date MM/YYYY | FIELD OF STUDY |
|---|---|---|---|
| Chalmers University of Technology | BSc | 06/81 | Building Engineering |
| Chalmers University of Technology | MSc | 06/84 | Env. Engineering |
| Lunds Institute of Technology | Ph.D | 10/94 | Env. Medicine |

## A. Personal Statement

I am an environmental epidemiologist and Professor in Public Health Sciences at Karlstad University, Sweden.

My research focuses is on early life exposure for environmental factors such as endocrine disrupting chemicals (EDCs), food and nutrition, life styles etc. and how such factors interact and impact on children´s health and development. This is done two major epidemiological studies in Sweden, the Dampness in Buildings and Health (DBH) study following more than 10,000 children from childhood up in adulthood and the SELMA study following more than 2,000 mother-child pairs from early pregnancy, over birth and up in school age.

I am involved in six major projects (where SELMA is playing a key role) in Europe and the U.S. I am PI for the epidemiological part in EDC-MixRisk (funded by Horizon 2020 with 6.233 million €) a study integrating epidemiological studies with experimental cell- and animal models in order to learn about how mixtures of EDCs impact on children´s health development in three domains (sexual development, neurodevelopment and metabolism) and which biological mechanisms that may be in action. I am PI for RACH-Mix (funded by Swedish Formas with 12 million SEK) aiming to develop methods for risk assessment of chemical mixtures. I am co-investigator in ENDpoiNTs and ATHENA (funded by Horizon 2020 with 6.89 and 6.56 million € respectively) with the aim to develop new screening tools for chemicals with endocrine disrupting properties. In the U.S., I am co-investigator in PRIME (funded by U.S. NIH with 2.5 million USD), focusing on food and nutrition in interaction with chemicals and human health partly based on SELMA-data, and APED (funded by U.S. NIH with 2 million USD) studying prenatal exposure for persistent chemicals and autism in children, a study conducted in Sweden.

My research have three major directions;

- Examine the importance of prenatal exposure for suspected or proven EDCs for children´s health and development
- Development of a new whole mixture approach for risk assessment of EDC mixtures by integrating human based epidemiology and experimental toxicology
- Identification of sources, time trends and replacement of EDCs

## B. Positions

**Positions and Employment**

06/85 Assistant professor Science Partner Technical Research Institute of Sweden)
06/98 Assistant professor Technical University of Denmark, Copenhagen (1998-2010)
10/98 Assistant professor Public Health Sciences, Karlstad University
05/05 Associate professor Public Health Sciences, Karlstad University
02/09 Professor and Department Chair of Public Health Sciences, Karlstad University
10/15 Adjunct professor Icahn School of Medicine at Mount Sinai, New York, USA

**Current position:**
Head of Public Health Sciences at Department of Health and Environment at Karlstad University

**Honors:**

2002 Best paper award. Indoor Air Journal 1999-2001.(Bornehag, C.G., Blomquist, G., Gyntelberg, F., Järvholm, B., Malmberg, P., Nielsen, A., Pershagen, G. (2001) Dampness in Buildings and Health. Nordic interdisciplinary review of the scientific evidence on associations between exposure to “dampness” and health effects, NORDDAMP. *Indoor Air* 2001;11:72-86.
2008 Member of ISIAQ Academy of Fellows.
2010 ISI Web of Knowledge. Highly Cited Article. Bornehag et al., 2001 (NORDDAMP), cited 445 times since 2001.

**Other Experience and Professional Memberships**

President and founding member of SWESIAQ. Swedish chapter of International Society of Indoor Air Quality and Climate, (ISIAQ). 2000-2009.

Board member of ISIAQ, International Society of Indoor Air Quality and Climate. 2006-2014.

Member of the Editorial Board of Indoor Air, International Journal of Indoor Environment and health. 2007 On-going.

Member of ISIAQ Academy of Fellows. 2008 On-going.

Member of International Science Committee for International Workshop on SVOC in the Indoor Environment, 1st hold in Beijing, China 2011 and 2nd hold in Wuhan, China 2013. 2011 On-going.

Member of the Editorial Board of Environmental Health. 2012 On going.

Visiting professor at Harvard School of Public Health (Boston) during the period March 1 to August 31, 2012.

Member of the board of directors in the newly established Swedish Toxicology Sciences Research Center (Swetox), which has been created in order to further improve Sweden’s ability to meet society’s need for safe chemicals and a non-toxic environment. 2014-2018.

Member of FORTE “elektorsförsamling”. 2015 On-going.

Member of scientific advisory board for HBM4EU. 2017 On-going.

**C. Contribution to Science**

Web of science per 2019-09-09; in total 104 peer review articles, h-index 31, 4,076 citations, average citation per item 39.2

Below peer review publications last 5 years (2015-2019)

1. Anna-Sofia Preece, Huan Shu, Malin Knutz, Sverre Wikström, Annette Krais, Christian Lindh, Ping-I Lin, Carl-Gustaf **Bornehag** (**2019**). Phthalate levels in indoor dust and associations to croup in the SELMA study. *In manuscript*
2. Anna-Sofia Preece, Huan Shu, Malin Knutz, Annette Krais, Christian Lindh, Carl-Gustaf **Bornehag** (**2019**). Phthalate levels in indoor dust and correlations to phthalate metabolites in urine of pregnant mothers in the SELMA study. *In manuscript*
3. Katherine Svensson, Eva Tanner, Chris Gennings, Sverre Wikström, Carl-Gustaf **Bornehag** (**2019**). Prenatal exposures to mixtures of endocrine disrupting chemicals and children’s growth up to six years of age in the SELMA study*. In manuscript*
4. Shu, H., Knutz, M., Lindh, C., Kraiss, A., **Bornehag, CG**. **(2019).** Indoor dust levels of phthalates as a source for human uptake. *In manuscript*
5. Duque et al., **Bornehag, CG**. **(2019).** Exposure for persistent organic pollutants and time-to-pregnancy in Swedish women. *Submitted*
6. Tanner, E., **Bornehag**, CG., Gennings, C. (**2019**) Dynamic Growth Metrics for Examining Prenatal Exposure Impacts on Child Growth: Application to Perfluorooctanoic Acid (PFOA) and Postnatal Weight Gain. *Submitted*
7. Shu, H., Knutz, M., Lindh, C., Kraiss, A., **Bornehag, CG**. **(2019).** PVC flooring material as a source for phthalates in indoor dust. *Submitted*
8. Wikström, S., Lin, D., Lindh, C., Shu, H., **Bornehag, CG**. **(2019).** Maternal serum levels of perfluoroalkyl acids in early pregnancy and offspring birth weight. *Scientific reports, Submitted*
9. **Bornehag**, CG., Engdahl, E., Unenge, M., Wikstrom, S., Lindh, C., Ruegg, J., Tanner, Gennings, C, (**2019**) Prenatal exposure for bisphenols and cognitive function in children at 7 years of age in the SELMA study. *JAMA peds. Submitted*
10. Tanner, E., Unenge, M., EWikstrom, S., Lindh, C., Kiviranta, H., Gennings, C., **Bornerhag**, CG. (**2019**). Early Prenatal Exposure to Suspected Endocrine Disruptor Mixtures is Associated with Lower IQ at Age Seven. *EnvInt, Accepted for publication*
11. Levie, Deborah; Derakhshan, Arash; Shu, Huan; Broeren, Maarten; de Poortere, Ralph; Peeters, Robin; **Bornehag**, Carl-Gustaf; Demeneix, Barbara; Korevaar, Tim. T. **(2019).** The association of maternal iodine status in early pregnancy with thyroid function in the SELMA study. *Thyroid*, *Accepted for publication*
12. Derakhshan, A., H. Shu, M. A. Broeren, R. A. de Poortere, S. Wikström, R. P. Peeters, B. Demeneix, T. I. Korevaar**, CG Bornehag**. **(2019).** Exposure for different alkyl phenols (BPA, BPF, BPS) and thyroid status in pregnant women. *Env Int, Accepted for publication*

13. Wikström, S., Lindh, C., Shu, H., **Bornehag, CG**. **(2019).** Early pregnancy serum levels of perfluoroalkyl substances and risk of preeclampsia in Swedish women. *Scientific reports. Accepted for publication*
14. **Bornehag, CG**., Reichenberg, A., Swan, S. (**2019**) Language Development of Young Children Is Not Linked to Phthalate Exposure—Reply. *JAMA peds*
15. Repouskou, A., Panagiotidou, E., Panagopoulou, L., Larsdotter Bisting, Tuck, A., Sjödin, M., Lindberg, J., Evangelos Bozas, E., Gennings C., **Bornehag, CG**., Damdimopoulou, P., Stamatakis, A., Kitraki, E. **(2019).** Gestational exposure to an epidemiologically defined mixture of phthalates leads to gonadal dysfunction in mouse offspring of both sexes. *Scientific reports. Accepted for publication*
16. **Bornehag, C. G**., Kitraki. E., Panagiotidou. E., Stamatakis. A., Ruden. C., Shu. H., Lindh. C., Ruegg. J., Gennings. C. **(2019).** A novel approach to chemical mixture risk assessment - Linking data from population based epidemiology and experimental animal tests. *Risk analysis. Accepted for publication*
17. Shu, H., Lindh, C., Wikström, S., **Bornehag, CG**. **(2019).** Time trends for PFAS exposure Temporal Trends and Predictors of Perfluoroalkyl substances Serum Levels in Swedish Pregnant Women in the SELMA study. *PLOSONE. Accepted for publication*
18. Soomro, MH., Baiz, N., Huel, G., Yazbeck, C., Botton, J., Heude, B., **Bornehag, CG**., Annesi-Maesano, I. (**2019).** Exposure to heavy metals during pregnancy related to gestational diabetes mellitus in diabetes-free mothers. *Science of the Total Environment Journal*. *Accepted for publication*
19. **Bornehag, C. G**., Lindh, C., Riechenberg, A., Wikström, S., Unenge Hallerback, M., Evans, S., Sathyanarayana, S., Barret, E., Nguyen, R., Bush, N., Swan, S. (**2018**). Prenatal phthalate exposure and language delay in early childhood in two pregnancy cohorts, SELMA and TIDES. *JAMA peds*. 2018. doi:10.1001/jamapediatrics.2018.3115
20. Koch, H. M., F. Lessmann, S. H. Swan, R. Hauser, M. Kolossa-Gehring, H. Frederiksen, A.-M. Andersson, C. Thomsen, A. K. Sakhi and **CG Bornehag** et al., (**2018**). Analyzing terephthalate metabolites in human urine as biomarkers of exposure: Importance of selection of metabolites and deconjugation enzyme. *Journal of Chromatography B*. 2018. Doi: 10.1016/j.jchromb.2018.09.035
21. Alavian-Ghavanini, A., P.-I. Lin, P. M. Lind, S. R. Rimfors, M. H. Lejonklou, L. Dunder, M. Tang, C. Lindh, **CG Bornehag** and J. Rüegg (**2018**). Prenatal Bisphenol A Exposure is Linked to Epigenetic Changes in Glutamate Receptor Subunit Gene Grin2b in Female Rats and Humans. *Scientific reports.* 2018 8(1): 11315.
22. **Bornehag, CG**, A. Reichenberg, M. U. Hallerback, S. Wikstrom, H. M. Koch and S. H. Swan. Reply to: Shukla et al., Commentary on: Prenatal exposure to acetaminophen and children's language development at 30 months. *European Psychiatry.* **2018 51**: 86.
23. Derakhshan, A., H. Shu, M. A. Broeren, R. A. de Poortere, S. Wikström, R. P. Peeters, B. Demeneix, **CG Bornehag** and T. I. Korevaar. Reference ranges and determinants of thyroid function during early pregnancy: the SELMA study. *The Journal of Clinical Endocrinology & Metabolism.* **2018 103**(9): 3548-3556.
24. Gennings, C., H. Shu, C. Rudén, M. Öberg, C. Lindh, H. Kiviranta and **CG Bornehag**. Incorporating regulatory guideline values in analysis of epidemiology data. *Environment international.* **2018 120**: 535-543.
25. Shu, H., Jonsson, BAG., Gennings, C., Lindh, C., Naberg, E., **Bornehag, CG** PVC Flooring at Home and Uptake of Phthalates in Pregnant Women. Indoor Air. **2018**. DOI:10.1111/ina.12508
26. **Bornehag, CG**, A. Reichenberg, M. U. Hallerback, S. Wikstrom, H. M. Koch and S. H. Swan (2018). Reply to: Shukla et al., Commentary on: Prenatal exposure to acetaminophen and children's language development at 30 months [1]. *European Psychiatry*. **2018 51**: 86.

27. Shu H, Jönsson BA, Gennings C, Svensson Å, Nånberg E, Lindh CH, Knutz M, Takaro TK, **Bornehag CG**. Temporal trends of phthalate exposures during 2007-2010 in Swedish pregnant women. *J Expo Sci Environ Epidemiol*. **2018** Feb 22;PubMed PMID: 29472621.

28. Soomro MH, Baiz N, Philippat C, Vernet C, Siroux V, Nichole Maesano C, Sanyal S, Slama R, **Bornehag CG**, Annesi-Maesano I. Prenatal Exposure to Phthalates and the Development of Eczema Phenotypes in Male Children: Results from the EDEN Mother-Child Cohort Study. *Environ Health Perspect*. **2018** Feb 2;126(2):027002. PubMed PMID: 29398652.

29. Shu H, Wikstrom S, Jönsson BAG, Lindh CH, Svensson Å, Nånberg E, **Bornehag CG**. Prenatal phthalate exposure was associated with croup in Swedish infants. *Acta Paediatr*. **2018** Jan 31. doi: 10.1111/apa.14245. [Epub ahead of print]

30. Bauer AZ, Kriebel D, Herbert MR, **Bornehag CG**, Swan SH. Prenatal paracetamol exposure and child neurodevelopment: A review. *Horm Behav*. **2018** Feb 2;PubMed PMID: 29341895.

31. **Bornehag CG**, Reichenberg A, Hallerback MU, Wikstrom S, Koch HM, Jonsson BA, Swan SH. Prenatal exposure to acetaminophen and children's language development at 30 months. *European Psychiatry*. **2018** Jan 10. pii: S0924-9338(17)32989-9. doi: 10.1016/j.eurpsy.2017.10.007. [Epub ahead of print] PMID: 29331486.

32. Engh L, Janson S, Svensson B, **Bornehag CG**, Eriksson UB. Swedish population-based study of pupils showed that foster children faced increased risks for ill health, negative lifestyles and school failure. *Acta Paediatr*. **2017** Oct;106(10):1635-1641. doi: 10.1111/apa.13966. Epub 2017 Aug 13. PMID: 28664570.

33. Hay-Schmidt A, Finkielman OTE, Jensen BAH, Høgsbro CF, Bak Holm J, Johansen KH, Jensen TK, Andrade AM, Swan SH, **Bornehag CG**, Brunak S, Jegou B, Kristiansen K, Kristensen DM. Prenatal exposure to paracetamol/acetaminophen and precursor aniline impairs masculinisation of male brain and behaviour. *Reproduction*. **2017** Aug;154(2):145-152. doi: 10.1530/REP-17-0165. Epub 2017 May 30. PMID: 28559473

34. Choi H, Schmidbauer N, **Bornehag CG**. Volatile organic compounds of possible microbial origin and their risks on childhood asthma and allergies within damp homes. Environ Int. **2017** Jan;98:143-151. doi: 10.1016/j.envint.2016.10.028. Epub 2016 Nov 9. PMID: 27838117.

35. Rendel F, Alfredsson CF, **Bornehag CG**, Sundström BE, Nånberg E. Effects of Di-isononyl Phthalate on Neuropeptide Y Expression in Differentiating Human Neuronal Cells. Basic Clin Pharmacol Toxicol. **2017** Mar;120(3):318-323. doi: 10.1111/bcpt.12670. Epub 2017 Jan 16. PMID: 27625336.

36. Vandenberg LN, Ågerstrand M, Beronius A, Beausoleil C, Bergman Å, Bero LA, **Bornehag CG,** Boyer CS, Cooper GS, Cotgreave I, Gee D, Grandjean P, Guyton KZ, Hass U, Heindel JJ, Jobling S, Kidd KA, Kortenkamp A, Macleod MR, Martin OV, Norinder U, Scheringer M, Thayer KA, Toppari J, Whaley P, Woodruff TJ, Rudén C. A proposed framework for the systematic review and integrated assessment (SYRINA) of endocrine disrupting chemicals. Environ Health. **2016** Jul 14;15(1):74. doi: 10.1186/s12940-016-0156-6. Review.PMID: 27412149

37. Choi H, Schmidbauer N, **Bornehag CG**. Non-microbial sources of microbial volatile organic compounds. Environ Res. **2016** Jul;148:127-136. doi: 10.1016/j.envres.2016.03.026. Epub 2016 Apr 1. PMID: 27043176.

38. Wang IJ, Chen CY, **Bornehag CG**. Bisphenol A exposure may increase the risk of development of atopic disorders in children. Int J Hyg Environ Health. **2016** May;219(3):311-6. doi: 10.1016/j.ijheh.2015.12.001. Epub 2015 Dec 11. PMID: 26765087.

39. Jensen TK, Frederiksen H, Kyhl HB, Lassen TH, Swan SH, **Bornehag CG**, Skakkebaek NE, Main KM, Lind DV, Husby S, Andersson AM. Prenatal Exposure to Phthalates and Anogenital Distance in Male

Infants from a Low-Exposed Danish Cohort (2010-2012). Environ Health Perspect. **2016** Jul;124(7):1107-13. doi: 10.1289/ehp.1509870. Epub 2015 Dec 15. PMID: 26672060.

40. Deng Q, Lu C, Norbäck D, **Bornehag CG**, Zhang Y, Liu W, Yuan H, Sundell J. Early life exposure to ambient air pollution and childhood asthma in China. Environ Res. **2015** Nov;143(Pt A):83-92. doi: 10.1016/j.envres.2015.09.032. Epub 2015 Oct 19. PMID: 26453943.
41. Ma P, Liu X, Wu J, Yan B, Zhang Y, Lu Y, Wu Y, Liu C, Guo J, Nanberg E, **Bornehag CG**, Yang X. Cognitive deficits and anxiety induced by diisononyl phthalate in mice and the neuroprotective effects of melatonin. Sci Rep. **2015** Oct 1;5:14676. doi: 10.1038/srep14676. PMID: 26424168.
42. Choi H, Thorne P, **Bornehag CG**. Response to Miller. Indoor Air. **2015** Feb;25(1):117. doi: 10.1111/ina.12131. No abstract available. PMID: 25594132.
43. Tang, J., Y. Yuan, C. Wei, X. Liao, J. Yuan, E. Nanberg, Y. Zhang, **CG Bornehag** and X. Yang (**2015**). "Neurobehavioral changes induced by di (2-ethylhexyl) phthalate and the protective effects of vitamin E in Kunming mice." Toxicology Research **4**(4): 1006-1015.
44. **Bornehag CG**, Carlstedt F, Jönsson BA, Lindh CH, Jensen TK, Bodin A, Jonsson C, Janson S, Swan SH. Prenatal phthalate exposures and anogenital distance in Swedish boys. Environ Health Perspect. **2015** Jan;123(1):101-7. doi: 10.1289/ehp.1408163. Epub 2014 Oct 29. PMID: 25353625.

## D. Research Support (2014-2018)

### Ongoing Research Support

| | |
|---|---|
| Funding | 12 million SEK |
| Source | Formas |
| Project/Title/Number | **RACH-Mix**; Project 2018-02279 |
| Role/PI/Co-I | PI |
| Brief description | RACH-Mix´s primary aim is to develop and demonstrate new strategies for risk assessment of mixtures of chemicals that complements traditional single compound and additivity methods. |
| Dates | 2019-01-01 – 2022-12-31 |

| | |
|---|---|
| Funding | 6.890 million € |
| Source | EU Horizon 2020 |
| Project/Title/Number | **ENDpoiNTs**; Project 825759 - |
| Role/PI/Co-I | CO-I |
| Brief description | ENDpoiNTs will meet the scientific and societal need for improved hazard and risk assessment of endocrine disrupting chemicals (EDCs) with regards to human neurodevelopment. |
| Dates | 2019-01-01 – 2024-12-31 |

| | |
|---|---|
| Funding | 6.56 million € |
| Source | EU Horizon 2020 |
| Project/Title/Number | **ATHENA**; Project 825161 |
| Role/PI/Co-I | CO-I |
| Brief description | ATHENA will improve hazard and risk assessment of endocrine disrupting chemicals (EDCs) with regards to thyroid functions. |
| Dates | 2019-01-01 – 2024-12-31 |

| | |
|---|---|
| Funding | 2.5 million USD |

| | |
|---|---|
| Source | NIH, USA |
| Project/Title/Number | **PRIME** |
| Role/PI/Co-I | CO-I |
| Brief description | PRIME is focusing on food habits, nutrion, chemicals and children´s metabolism and growth |
| Dates | 2018-07-01 – 2022-06-31 |

| | |
|---|---|
| Funding | 2.1 million SEK |
| Source | County Council of Värmland, Sweden |
| Project/Title/Number | **PhD-student** |
| Role/PI/Co-I | PI |
| Brief description | Early live exposure for EDCs and metabolism and growth in children, to be conducted in PRIME |
| Dates | 2018-07-01 – 2022-06-31 |

| | |
|---|---|
| Funding | 6.233 million € |
| Source | EU Horizon 2020 |
| Project/Title/Number | **EDC-MixRisk** |
| Role/PI/Co-I | CO-I |
| Brief description | Integrating epidemiology (SELMA) and experimental toxicology for better risk assessment of endocrine disrupting chemicals |
| Dates | 2015-05-01 – 2019-04-30 |

| | |
|---|---|
| Funding | 1.15 million SEK |
| Source | County Council of Värmland, Sweden |
| Project/Title/Number | **SELMA, health examination of 1,500 children at 7 years of age** |
| Role/PI/Co-I | PI |
| Brief description | Data collection in the SELMA study |
| Dates | 2014-01-01 – 2016-12-31 |

| | |
|---|---|
| Funding | 3.5 million SEK |
| Source | Forte, Sweden |
| Project/Title/Number | **SELMA, prenatal EDC exposure and down regulation of vaccination in 7 year old children** |
| Role/PI/Co-I | CO-I for epidemiological work package. PI is Christian Lindh at Lund University |
| Brief description | SELMA study |
| Dates | 2015-05-01 – 2019-04-30 |