



Conference on ‘Childhood Nutrition and Obesity: Current Status and Future Challenges’ Symposium 1: Current Status

Early feeding practices and family structure: associations with overweight in children

Monica Hunsberger, on behalf of the IDEFICS Consortium

Public Health Epidemiology Unit, Department of Community Medicine and Public Health, Sahlgrenska Academy,
University of Gothenburg, Box 454, SE-405 30 Gothenburg, Sweden

The aim of this review is to examine two factors that may be associated with development of childhood overweight: early feeding, namely exclusive breastfeeding practices; family structure. Findings from the Identification and prevention of Dietary- and lifestyle-induced health Effects In Children and infantS (IDEFICS) study are presented in the context of the literature. IDEFICS is a multi-centre European study exploring the risks for overweight and obesity in children, which recruited 16 224 children aged 2–9 years from September 2007 to June 2008 at survey centres in Italy, Estonia, Cyprus, Belgium, Sweden, Hungary, Germany and Spain. Among the IDEFICS sample, after controlling for confounders, exclusive breastfeeding for 4–6 months was protective of overweight (including obesity) when compared with children never exclusively breastfed (OR 0.73, 95% CI 0.63, 0.85). Family structure and number of siblings may also be associated with overweight. IDEFICS children without siblings were more likely (OR 1.52, 95% CI 1.34, 1.72) to be overweight than their peers with siblings when controlling for factors related to childhood overweight such as country, parental education, parental weight, maternal age, child’s age, birth weight and gender. Both early feeding practices and family structure play a role in the future development of obesity. The impact of breastfeeding on future development of overweight is dependent upon the dose. Exclusive breastfeeding for the recommended 6 months appears to be protective of overweight. Family structure is also an important component and emerging research suggests only children are at increased risk for overweight in comparison with those with siblings. In European countries, approximately 22 million children are overweight. Early dietary exposures, genetic, environmental and social factors have all been proposed as potential causal factors. Two such factors include exclusive breastfeeding and the impact of being an only child. We have investigated these two factors for associations with overweight; our studies, in the context of previous findings, are the focus of this review.

Childhood overweight: Breastfeeding: Early feeding practices: Family structure: Only child

Early nutrition and overweight

A number of studies have examined early nutrition, including breastfeeding, and associations with obesity with conflicting results^(1–9). Differences in findings are likely due to a lack of control for confounding variables,

small sample size, socioeconomic status and other differences such as subject age at time of measurement and family structure⁽¹⁰⁾. Some studies have found a positive, dose-dependent association between breastfeeding and weight status^(11–13), while others have reported a nonlinear positive response^(14–16). On the contrary, other studies



have demonstrated little or no protective association between breastfeeding and overweight; including a longitudinal study of infant feeding and obesity which found that exclusive breastfeeding was not related to being overweight or obese during adult life^(17–21). Similarly, a systematic analysis conducted by the WHO⁽²²⁾ and a systematic review of the literature found that after adjustment for maternal overweight the effect of breastfeeding was eliminated⁽²³⁾. It has been suggested that breastfeeding alone does not protect children from overweight but rather other healthy lifestyle habits or other social advantages of mothers who chose to breastfeed⁽¹⁰⁾. While the relationship between breastfeeding and obesity has not been fully elucidated, it is recommended by the WHO and Cochrane Review that children are exclusively breastfed for 6 months due to other known benefits and this is supported by the ESPGHAN Committee on Nutrition, which recommended children be exclusively breastfed for about 6 months^(24–26).

Recently, our group examined exposure to exclusive breastfeeding and overweight in the Identification and prevention of Dietary- and lifestyle-induced health Effects In Children and infantS (IDEFICS) study. IDEFICS is a multi-centre European study involving eight countries: Italy, Estonia, Cyprus, Belgium, Sweden, Hungary, Germany and Spain. Community-based survey centres in each of the participating countries collected information when children were age 2–9 years from September 2007 until June 2008 at survey centres that cannot be considered country representative. In total, over 16000 children participated in IDEFICS⁽²⁷⁾. From the IDEFICS population, children were included in the first study if their exposure to exclusive breastfeeding could be defined⁽²⁸⁾. After exclusions, the total sample size in our exclusive breastfeeding study was 14726 children with sample sizes across countries ranging from 1399 in Spain to 2431 in Hungary.

Characteristics by survey centre have been previously published in detail⁽²⁸⁾. In brief, the prevalence of overweight was 19.4%, ranging from a high of 42.3% in Italy to a low of 8.3% in Belgium at baseline data collection in IDEFICS. Children were aged 2–9 years at the baseline survey with a mean age of 6 years and were analysed in two age groups of similar size, pre-school age (2 to <6 years) and school age (6–9 years). The gender distribution is nearly equal across survey centres.

When all centres are combined, <20% of IDEFICS children were never exclusively breastfed for at least some period although there are distinct differences across the countries. For example, in Belgium 46.1% of the children were never breastfed whereas in Estonia only 9.9% of the children were never breastfed⁽²⁸⁾. The mean duration of exclusive breastfeeding was 3.2 months across all survey centres.

Exclusive breastfeeding and overweight/obesity combined were examined with adjustment for survey country, child age, sex and birth weight, included household income, maternal education, maternal overweight/obesity, single or dual parent family structure, the presence of one or more foreign born parents, and tobacco use

during pregnancy. In our fully adjusted model, breastfeeding exclusively for 4–6 months was protective of overweight (including obesity) when compared with children never exclusively breastfed (OR 0.73, 95% CI 0.63, 0.85). In addition, exclusive breastfeeding for 6 months offered slightly more protection than 4 and 5 months combined (OR 0.71, 95% CI 0.58, 0.85). Findings were consistent between boys and girls. The associations could not be explained by socioeconomic characteristics or maternal overweight.

Since the use of BMI as an appropriate means of assessing childhood weight-related health risks is not clear⁽²⁹⁾, our group further assessed overweight/obesity with skinfold measures and waist:height ratio. A logistic regression model and generalised linear regression model respectively demonstrated waist:height ratio and per cent body fatness assessed by skinfold measure both agreed with our initial logistic regression findings and support our use of BMI as a binary outcome representing overweight children. Comparing obesity prevalence by BMI categories with waist:height ratio, there was 86.19% agreement among normal weight children and 67.25% among overweight/obese. Agreement by skinfold assessment was slightly greater, in the normal weight BMI category there was 86.9% agreement and in the overweight/obese 75.95% agreement.

More recently, a novel analysis of variables predictive of adult obesity was carried out by the Foresight Obesity System Map group; a project of the UK government think-tank Foresight⁽³⁰⁾. A two-way framework of past/fixable and present/modifiable factors are presented for a sample (n 11752)⁽³¹⁾. Breastfeeding for any amount of time and normal birth weight were included as positive conditioning factors or factors that occurred in the past that cannot be changed⁽³¹⁾. Individuals identified in the highest risk category at age 11 years were approximately two times as likely to become overweight by age 23 years and obese in their 30s and 40s as opposed to their low-risk peers⁽³¹⁾. These findings support the protective role of breastfeeding. Further, a systematic literature review that included sixty papers concluded the evidence of a protective dose/duration effect of breastfeeding against overweight and obesity in childhood and adolescence is convincing⁽³²⁾. The authors also concluded that there is probable evidence that exclusive breastfeeding for longer than 4 months is associated with slower weight gain from 6 to 12 months and may be the reason behind the reduced risk of later overweight and obesity⁽³²⁾. In light of these findings, there is good evidence that breastfeeding is protective against the development of overweight later in life.

Family structure and overweight

In addition to early nutrition, the role of family structure may also have important implications for future childhood overweight and obesity. However, the role of family structure in the development of obesity is not well elucidated. Singleton status was identified as a risk factor for obesity in one Norwegian population study⁽³³⁾, and the research suggests that first-born children receive

more 'quality time' per day than those born into a household with a sibling⁽³⁴⁾. Furthermore, the influence of social networks is likely an important component of overweight development^(8,9).

Our group investigated the role of family structure and overweight among the IDEFICS children across eight European countries. In this study, 12 720 children were included based upon completeness of family structure data⁽³⁵⁾. All survey centres obtained ethics approval from their respective authority. Parents or legal guardians provided written informed consent on behalf of their children for data collection and specimen collection and children gave oral consent. Detailed information about IDEFICS survey protocol has been previously published⁽²⁷⁾ as have the detailed methods of this study⁽³⁵⁾.

While breastfeeding is protective of overweight, being an only child is not. IDEFICS children without siblings were more likely (OR 1.52, 95% CI 1.34, 1.72) to be overweight than their peers with siblings when controlling for factors related to childhood overweight (parental education, parental weight, maternal age, child's age, birth weight and gender) and for survey country. In fact, the longer a child remains an only child, the stronger the association with overweight. As previously reported by our group, among older singletons the association with overweight (OR 1.70, 95% CI 1.44, 2.01) was greater than for younger singletons (OR 1.32, 95% CI 1.10, 1.60)⁽³²⁾. The potential behavioural mediators examined (playtime outdoors, screen time/d, propensity to consume sugar or fat, parental attitudes towards food rewards and television in the child's bedroom) did not attenuate the relationship between only children and overweight with associated OR ranging from 1.51 to 1.58 when each mediator was explored individually and in combination. In a sensitivity analysis, having a sibling was protective regardless of birth order (twins or those with older siblings *v.* only younger sibling) when only children were compared with those with siblings. Additional analyses suggested that children who have always had a sibling were slightly more protected from overweight than those that were previously a singleton until the arrival of a younger sibling but this finding was not statistically significant.

New findings from our group further demonstrate only children are at increased risk for overweight. Among the IDEFICS sample, children with the greatest number of siblings had the lowest BMI z-scores in cross-sectional analyses and over a 2-year follow-up period the risk of incidence of overweight/obesity was significantly lowered by the greater the number of siblings living in the household⁽³⁶⁾.

Limited research has examined the role of siblings in the home. Other studies have focused on family structure but have placed emphasis on the adults in the home rather than siblings. For example, a recent study in South Korea examined the relationship between child weight status by household structure but did not report on sibling status⁽³⁷⁾. In contrast to the limited studies that have found a relationship between family structure and childhood weight status, an Icelandic research group reported no association between family structure

and the prevalence of overweight and obesity among 16- to 20-year-old adolescents⁽³⁸⁾.

Conclusions

The present review highlights two factors that may be important to achieving a healthy weight both early in life and in the future. While overweight is multi-factorial in nature, exclusive breastfeeding and family structure are two factors that are likely to have an impact. Exclusive breastfeeding exposure was protective of overweight in our study, in part because we made a distinction between exclusive breastfeeding and partial or any breastfeeding. Our findings support the recommendation to exclusively breastfeed children for 6 months as do the findings of a recent systematic review⁽³²⁾. Breastfeeding policies that support women in the endeavour to exclusively breastfeed for 4–6 months, with 6 months being an optimal goal, may improve public health as many nations struggle to reduce childhood overweight prevalence. For a thorough review of the topic, see the systematic analysis conducted by the WHO⁽²²⁾ and two systematic reviews of the literature, the first includes both published and unpublished results and the latter only published results^(23,32).

Further, a limited body of research appears to demonstrate that only children are at increased risk for overweight. In our study, we found that only children were at risk for overweight and this risk was not attenuated by a number of potential behavioural mediators. The longer a child remains an only child in the household the stronger the association with overweight. This may have important parenting implications such that parents of only children may wish to limit screen time and encourage physical play time in addition to other lifestyle factors, such as feeding practices, that contribute to overweight. More research is needed to fully understand the associations between family structure and risk for overweight.

Our group will continue to explore many aspects of childhood overweight development and prevention in the continuation study I.Family. To learn more about IDEFICS or I.Family visit <http://www.idefics.eu/Idefics/> and <http://www.ifamilystudy.eu>, respectively. I.Family is EC funded FP7 Project no. 266044.

Acknowledgements

The author thanks IDEFICS collaborators: Lauren Lissner, Annarita Formisano, Alfonso Siani, Gabriele Eiben, Anna Reeske, Anne Lanfer, Charalampos Hadjigeorgiou, Dénes Molnar, Karin Bammann, Lucia A. Reisch, Luis A. Moreno, Michael Tornaritis, Paola Russo, Stefaan De Henauw and Toomas Veidebaum.

Financial Support

The research presented in this work has been supported by the European community within the 6th RTD Framework Programme Contract No. 016181 (FOOD).



Conflicts of Interest

None.

Authorship

This proceedings paper is based upon work previously published by the author and the author's collaborators who are acknowledged. This work was completed by the presenting author on behalf of the IDEFICS Consortium.

References

1. Watson R (2008) EU parliament backs 30 minutes' exercise a day for all children to tackle obesity. *BMJ* **337**, a1892.
2. Chen A & Escarce J (2010) Family structure and childhood obesity, early childhood longitudinal study-kindergarten cohort. *Prev Chronic Dis* **7**, A50.
3. Hesketh K, Crawford D, Salmon J *et al.* (2007) Association between family circumstance and weight status of Australian children. *Int J Pediatr Obes* **2**, 86–96.
4. Sullivan A, Joshi H, Ketende S *et al.* (2010) The consequences at age 7 of early childhood disadvantage in Northern Ireland and Great Britain. Belfast: Office of the First Minister and Deputy First Minister.
5. Mazur A, Klimek K, Telega G *et al.* (2008) Risk factors for obesity development in school children from south-eastern Poland. *Ann Agric Environ Med* **15**, 281–285.
6. Gopinath B, Baur LA, Burlutsky G *et al.* (2012) Socio-economic, familial and perinatal factors associated with obesity in Sydney schoolchildren. *J Paediatr Child Health* **48**, 44–51.
7. Moens E, Braet C, Bosmans G *et al.* (2009) Unfavorable family characteristics and their association with childhood obesity: a cross-sectional study. *Eur Eat Disord Rev* **17**, 315–323.
8. Christakis NA & Fowler JH (2007) The spread of obesity in a large social network over 32 years. *N Engl J Med* **357**, 370–379.
9. Auld MC (2011) Effect of large-scale social interactions on body weight. *J Health Econ* **30**, 303–316.
10. CDC, Division of Nutrition and Physical Activity (2007) *Does Breastfeeding Reduce the Risk of Pediatric Overweight? Research to Practice Series No.4*. Atlanta: Centers for Disease Control and Prevention.
11. Kramer MS (1981) Do breast-feeding and delayed introduction of solid foods protect against subsequent obesity? *J Pediatr* **98**, 883–887.
12. Arenz S, Ruckerl R, Koletzko B *et al.* (2004) Breastfeeding and childhood obesity – systematic review. *Int J Obes Relat Metab Disord* **28**, 1247–1256.
13. Harder T, Bergmann R, Kallischnigg G *et al.* (2005) Duration of breastfeeding and risk of overweight: a meta-analysis. *Am J Epidemiol* **162**, 397–403.
14. von Kries R, Doletzko B, Sauerwald T *et al.* (1999) Breast feeding and obesity: cross sectional study. *BMJ* **319**, 147–150.
15. Woo JG, Dolan LM, Morrow AL *et al.* (2008) Breastfeeding helps explain racial and socioeconomic status disparities in adolescent adiposity. *Pediatrics* **121**, 458–465.
16. Gillman MW, Rifas-Shiman SL, Camargo CA *et al.* (2001) Risk of overweight among adolescents who were breastfed as infants. *J Am Med Assoc* **285**, 2461–2467.
17. Toschke AM, Martin RM, von Kries R *et al.* (2007) Infant feeding method and obesity: body mass index and dual-energy X-ray absorptiometry measurements at 9–10 y of age from the Avon Longitudinal Study of Parents and Children (ALSPAC). *Am J Clin Nutr* **85**, 1578–1585.
18. Seach KA, Dharmage SC, Lowe AJ *et al.* (2010) Delayed introduction of solid feeding reduces child overweight and obesity at 10 years. *Int J Obes* **34**, 1475–1479.
19. Huus K, Ludvigsson JF, Enskär K *et al.* (2008) Exclusive breastfeeding of Swedish children and its possible influence on the development of obesity: a prospective cohort study. *BMC Pediatr* **8**, 42–47.
20. Kramer MS, Matush L, Vanilovich I *et al.* (2007) Effects of prolonged and exclusive breastfeeding on child height, weight, adiposity, and blood pressure at age 6.5 y: evidence from a large randomized trial. *Am J Clin Nutr* **86**, 1717–1721.
21. Michels KB, Willett WC, Graubard BI *et al.* (2007) A longitudinal study of infant feeding and obesity throughout life course. *Int J Obes* **31**, 1078–1085.
22. World Health Organization, Horta BL, Bahl R, Martines JC *et al.* (2007) *Evidence of the Long-Term Effects of Breastfeeding. Systematic Reviews and Meta-Analyses*. Geneva, Switzerland: WHO Press, available at: http://whqlibdoc.who.int/publications/2007/9789241595230_eng.pdf (accessed June 2011).
23. Owen CG, Martin RM, Whincup PH *et al.* (2005) The effect of breastfeeding on mean body mass index throughout life: a quantitative review of published and unpublished observational evidence. *Am J Clin Nutr* **82**, 1298–1307.
24. ESPGHAN Committee on Nutrition; Agostoni C, Braegger C, Decsi T *et al.* (2009) Breast-feeding: A Commentary by the ESPGHAN Committee on Nutrition. *J Pediatr Gastroenterol Nutr* **49**, 112–125.
25. World Health Organization (2011). Media Centre Statement 15 January 2011. Exclusive breastfeeding for six months best for babies everywhere. Available at: http://www.who.int/mediacentre/news/statements/2011/breastfeeding_20110115/en/index.html# (accessed June 2011).
26. Kramer MS, Kakuma R (2009) Optimal Duration of Exclusive Breastfeeding (Review). *Cochrane database of Systemic reviews* Issue 8, Article No CD003517.
27. Ahrens W, Bammann K, Siani A *et al.* (2011). The IDEFICS study: design, participation, socio-demographic characteristics and compliance. *Int J Obes* **35**, s3–s15.
28. Hunsberger M, Lanfer A, Reeske A *et al.* (2012). Infant feeding practices and prevalence of obesity in eight European countries – the IDEFICS study. *Public Health Nutr* **16**, 219–227.
29. Flegal KM & Ogden CL (2011) Childhood obesity: are we all speaking the same language? *Adv. Nutr* **2**, 159S–166S.
30. Butland B, Jebb S, Kopelman P *et al.* (2007) Foresight tackling obesities: future choices-project report. Available at: <http://bis.ecgroup.net/Publications/Foresight/TacklingObesities/071184X.aspx> (accessed Oct 2013).
31. Potter CM & Ulijaszek SJ. (2013) Predicting adult obesity from measures in earlier life. *JECH* (Epublication ahead of print version).
32. Hörnell A, Lagström H, Lande B *et al.* (2013) Breastfeeding, introduction of other foods and effects on health: a systematic literature review for the 5th Nordic Nutrition Recommendations. *Food Nutr Res* **57**, 20823.
33. Jüliusson PB, Eide GE, Roelants M *et al.* (2010) Overweight and obesity in Norwegian children: prevalence and sociodemographic factors. *Acta Paediatr* **99**, 900–905.



34. Price J. (2008) Parent-child quality time: does birth order matter? *J Hum Resources* **43**, 240–265.
35. Hunsberger M, Formisano A, Reisch L *et al.* (2012) Overweight in singletons compared to children with siblings: the IDEFICS study. *Nutr Diabetes* **2**, e56.
36. Formisano A, Hunsberger M, Bammann K *et al.* (2013) Family structure and childhood obesity: results of the IDEFICS Project. *Public Health Nutr* **20**, 1–9.
37. Eidsdóttir SP, Kristjánsson ÁI, Sigfúsdóttir ID *et al.* (2013) Secular trends in overweight and obesity among Icelandic adolescents: do parental education levels and family structure play a part? *Scand J Public Health* **41**, 384–391.
38. Lee HS, Duffey KJ, Kim CI *et al.* (2013) The relationship between family and child weight status by household structure in South Korea: 2007–2010. *Nutr Diabetes* **3**, e73.