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# Milk powder in relation to gluten intake and the risk of celiac disease during early childhood: a Swedish case-control study

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## Study Objectives

To evaluate the association of milk powder in relation to gluten intake with the risk of celiac disease in Swedish genetically susceptible children.

## Background

- Swedish genetically susceptible children are at a 2-fold risk of developing celiac disease before 3 years of age compared with at genetic risk children from the US (1).
- Milk powder and gluten are common components in the Swedish infant diet; almost 70% consumes milk cereal drink (2) and nearly 90% commercial porridge (3).
- High gluten intake during early childhood has been associated with increased risk of celiac disease in Swedish children (4), but not in other countries (5).

## Methods

- The Environmental Determinants of Type 1 Diabetes in The Young (TEDDY) study screens children carrying HLA-risk genotypes for celiac disease.
- Tissue transglutaminase autoantibodies (tTGA) were measured annually from 2 years of age using radioligand binding assays. tTGA positive children were re-tested after 3-6 months and referred to a pediatrician for evaluation of celiac disease if being persistently positive. Previous serum samples were retrospectively analyzed to set the time-point of seroconversion.
- A 1-to-3 nested case-control study comprised of 207 Swedish children with celiac disease and 621 controls who were matched for sex, birth year, and HLA genotype.
- A 3-day food record collected at 6, 9, 12, 18 and 24 months of age, respectively, was used to estimate the mean intake of milk powder and gluten (g/day and g/kg body weight/day).

## Statistical Analysis

- Conditional logistic regression calculated odds ratios (OR) at last intake, sum of all intakes and for each time-point prior to seroconversion of tTGA positivity.
- Data were adjusted for having a first-degree relative with celiac disease (FDR-CD) and milk powder intake adjusted for gluten intake.

- References:
- Liu E et al NEJM (2014)
  - Wibberger M et al SJPB (2014)
  - Almquist-Tangen G et al Acta Paediatr (2013)
  - Aronsson CA et al CGH (2016)
  - Crespo-Escobar P et al AJCL (2017)

## Conclusion

- Intake of milk powder during the first 2 years of life did not affect the risk of celiac disease in genetically susceptible children.
- Large intake of gluten increased the risk of celiac disease in early childhood.

## Results

- Intake of milk powder did not affect the risk of celiac disease at last intake prior to seroconversion of tTGA positivity (OR=1.00; 95% CI=0.99-1.01; p=0.937) or at any given time (Table 1, Figure 1).
- Gluten intake increased the risk of celiac disease when estimated in grams/day (OR=1.09; 95% CI=1.03-1.16; p=0.004, Table 2, Figure 2) and grams/kg body weight/day (OR=2.78; 95% CI=1.38-5.62; p=0.004) prior to seroconversion of tTGA positivity.
- The highest risk of celiac disease was observed at 18 months of age for gluten intake in grams/day (OR=1.12; 95% CI=1.04-1.21; p=0.004, Table 2, Figure 2) and grams/kg body weight/day (OR=3.95; 95% CI=1.59-9.82; p=0.003).

Table 1. Mean daily intake of milk powder (g/day) and risk of celiac disease after adjusting for having a FDR-CD and gluten intake.

Food Data	Cases		Controls		OR (CI 95%)	p-value
	N	Mean g/day (SD)	N	Mean g/day (SD)		
Last intake <sup>i</sup>	207	17.5 (14.6)	621	17.4 (14.1)	1.0 (0.99-1.01)	0.937
Sum all intakes <sup>ii</sup>	207	93.3 (52.8)	621	88.6 (53.5)	1.0 (0.998-1.004)	0.662
Intake at:						
3 months	207	6.0 (9.6)	618	7.1 (10.5)	0.99 (0.97-1.01)	0.159
6 months	202	15.9 (12.9)	598	15.3 (12.7)	1.0 (0.99-1.02)	0.643
9 months	198	28.1 (17.1)	589	25.4 (16.6)	1.01 (1.0-1.02)	0.069
12 months	192	27.2 (15.1)	554	25.4 (14.8)	1.01 (1.0-1.02)	0.181
18 months	146	18.7 (13.2)	433	18.1 (13.1)	1.0 (0.98-1.02)	0.983
24 months	103	13.3 (13.9)	315	14.7 (12.6)	0.99 (0.97-1.01)	0.202

<sup>i</sup> Milk powder intake reported at the last visit prior to seroconversion of tTGA  
<sup>ii</sup> Total intake prior of milk powder to seroconversion of tTGA

Table 2. Mean daily intake of gluten (g/day) and risk of celiac disease after adjusting for having a FDR-CD.

Food Data	Cases		Controls		OR (CI 95%)	p-value
	N	Mean g/day (SD)	N	Mean g/day (SD)		
Last intake <sup>i</sup>	207	5.5 (2.7)	621	4.9 (2.6)	1.09 (1.03-1.16)	0.004
Sum all intakes <sup>ii</sup>	207	14.1 (7.2)	207	13.0 (7.0)	1.03 (1.01-1.06)	0.021
Intake at:						
3 months	207	0.0 (0.1)	618	0.0 (0.0)	2.94 (0.17-51.4)	0.461
6 months	202	0.6 (0.9)	598	0.6 (1.0)	1.03 (0.86-1.22)	0.779
9 months	198	2.6 (1.5)	589	2.5 (1.7)	1.02 (0.93-1.13)	0.642
12 months	192	4.2 (2.0)	554	4.1 (2.1)	1.02 (0.94-1.11)	0.592
18 months	146	5.8 (2.7)	433	5.0 (2.3)	1.12 (1.04-1.21)	0.004
24 months	103	6.0 (2.7)	315	5.6 (2.5)	1.04 (0.96-1.14)	0.340

<sup>i</sup> Gluten intake reported at the last visit prior to seroconversion of tTGA  
<sup>ii</sup> Total intake of gluten prior to seroconversion of tTGA

Figure 1. Milk powder intake and risk of celiac disease, adjusted for having a FDR-CD and gluten intake.

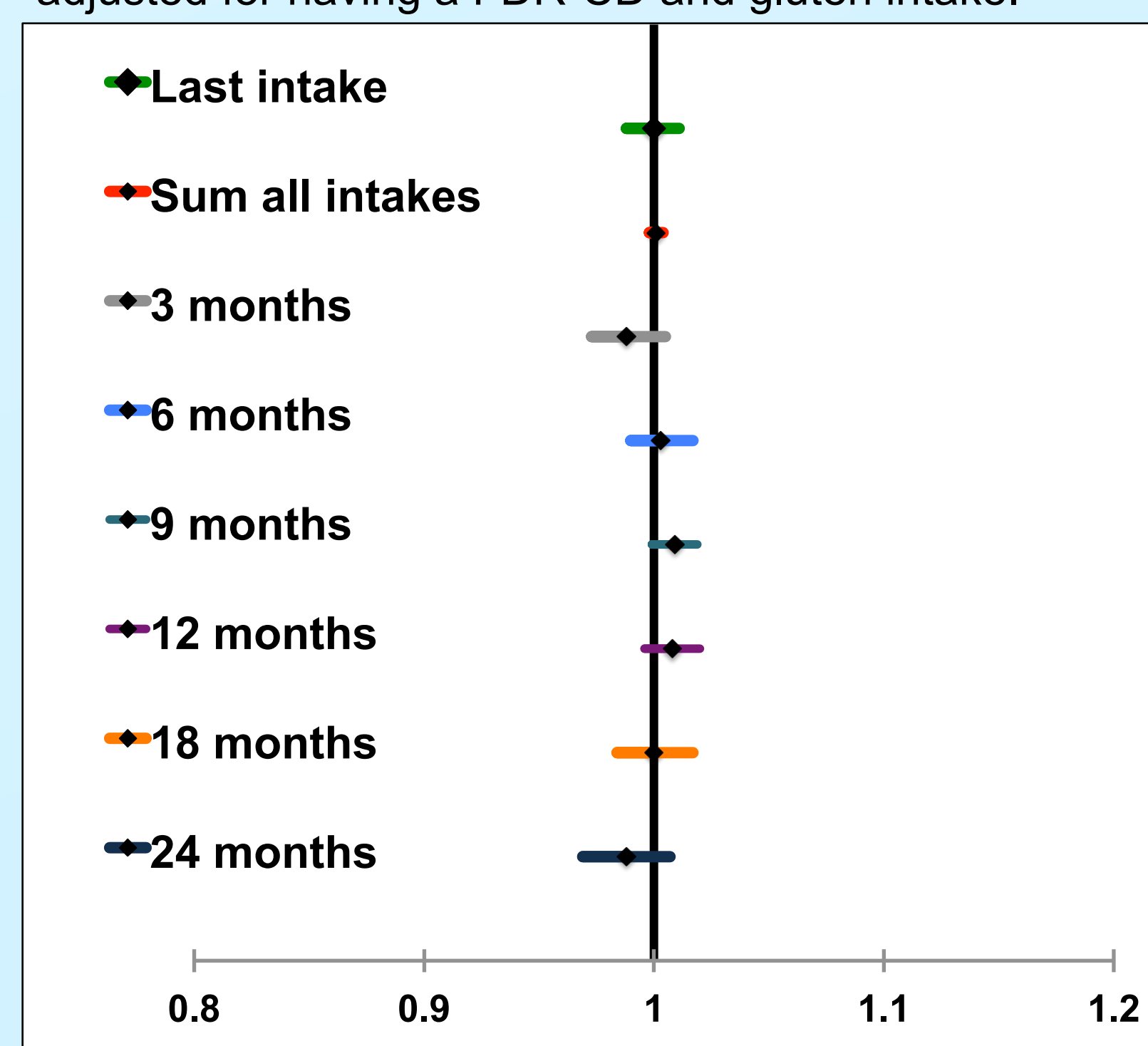
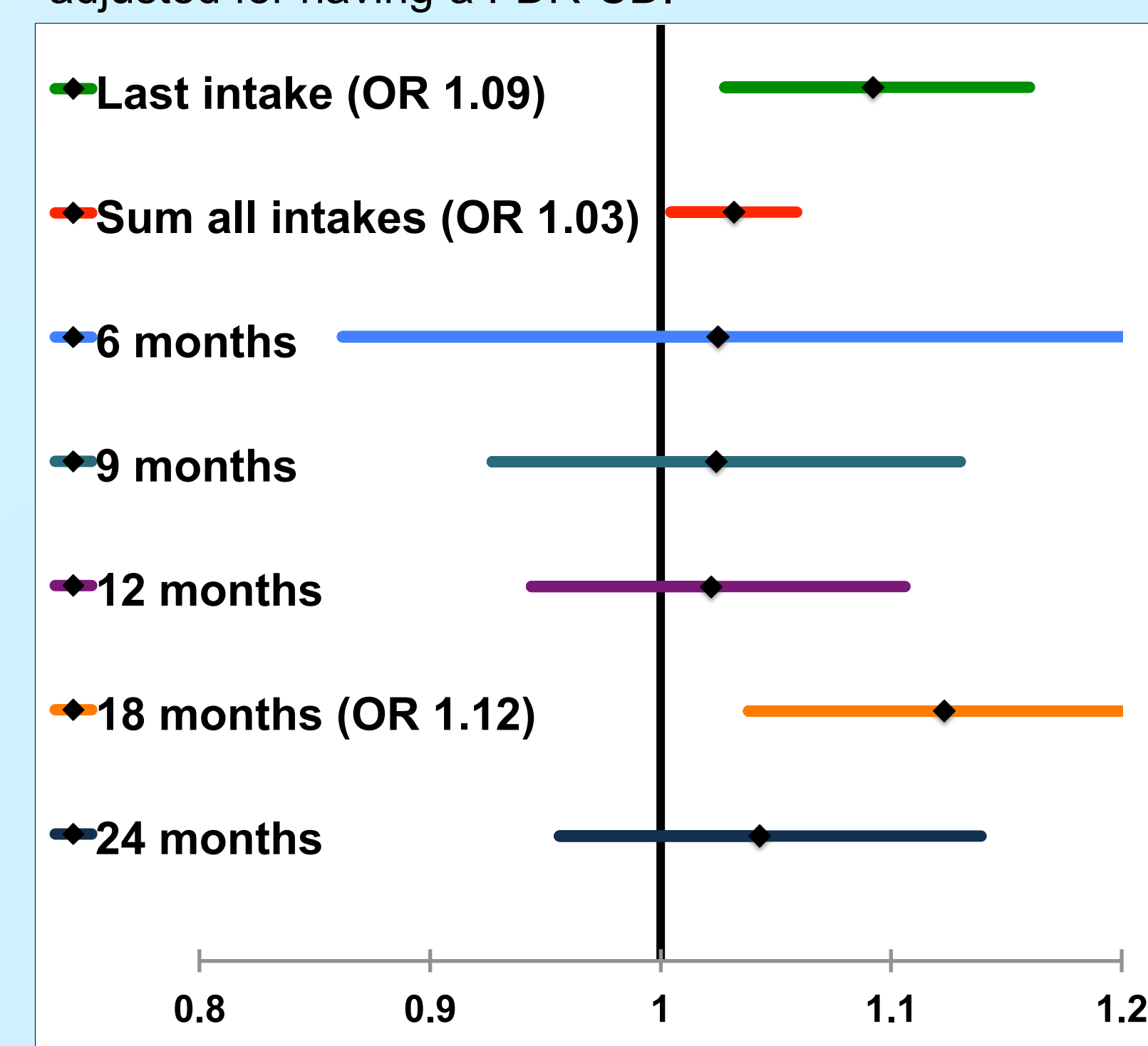


Figure 2. Gluten intake and risk of celiac disease, adjusted for having a FDR-CD.



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