Family socio-economic status and childhood coeliac disease seem to be unrelated—A cross-sectional screening study

Fredrik Norström¹ | Fedinah Namatovu² | Annelie Carlsson³ | Lotta Högberg⁴ | Anneli Ivarsson¹ | Anna Myléus¹,⁵

¹Department of Epidemiology and Global Health, Umeå University, Umeå, Sweden
²Department of Historical, Philosophical and Religious Studies, Umeå University, Umeå, Sweden
³Department of Paediatrics, Clinical Sciences, Skåne University Hospital, Lund University, Lund, Sweden
⁴Department of Paediatrics, Norrköping Hospital, Linköping University, Norrköping, Sweden
⁵Department of Public Health and Clinical Medicine, Family Medicine, Umeå University, Umeå, Sweden

Correspondence
Fredrik Norström, Department of Epidemiology and Global Health, Umeå University, SE-901 87 Umeå, Sweden.
Email: fredrik.norstrom@umu.se

Funding information
This study was funded by the Swedish Research Council, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, the Swedish Council for Working Life and Social Research, the Swedish Coeliac Association's research fund and Västerbotten County Council.

Abstract
Aim: The aim of our study was to examine whether there is a difference in coeliac disease prevalence in regard to parents' education level and occupation, and whether this differs between screened and clinically diagnosed children at the age of 12 years.

Methods: The study, Exploring the Iceberg of Celiacs in Sweden (ETICS), was a school-based screening study of 12-year-old children that was undertaken during the school years 2005/2006 and 2009/2010. Data on parental education and occupation were reported from parents of the children. Specifically, by parents of 10 710 children without coeliac disease, 88 children diagnosed with coeliac disease through clinical care, and 231 who were diagnosed during the study.

Results: There were no statistically significant associations between occupation and coeliac disease for either the clinically detected (prevalence ratio 1.16; confidence interval 0.76-1.76) or screening-detected coeliac disease cases (prevalence ratio 0.86; confidence interval 0.66-1.12) in comparison with children with no coeliac disease. Also, there were no statistically significant associations for parental education and coeliac disease diagnosis.

Conclusion: There was no apparent relationship between coeliac disease and socio-economic position. Using parents' socio-economic status as a tool to help identify children more likely to have coeliac disease is not recommended.

KEYWORDS
children, coeliac disease, education, occupation, screening

1 | BACKGROUND

Coeliac disease is a common genetic autoimmune disease that is characterised by a permanent intolerance to gluten. The only effective treatment for coeliac disease is a life-long gluten-free diet, which in most patients leads to the recovery of the damaged mucosa of the small intestine.² The prevalence of coeliac disease has commonly been reported to be around 1% in Western populations,² but there are also studies that have shown a prevalence as high as 2%-3% in Finland and Sweden.³ ⁴ Moreover, screening studies have revealed that the majority of coeliac disease patients are undiagnosed.⁴ ⁵ It is widely known that the risk of having coeliac disease is strongly linked to genetics and that the human leucocyte antigens of isotype DQ2 and DQ8 are necessary to develop the disease.¹ However, not all persons who are...
genetically predisposed go on to develop coeliac disease, which raises more questions on the aetiology of the disease. There is limited knowledge about other factors that are linked to the development of coeliac disease, although environmental factors such as infant feeding practices and infections have been associated with disease development.6-8

Some studies on the aetiology of coeliac disease have investigated the role of socio-economic factors such as occupation, income and education, but evidence is still sparse and in some cases contradictory.9-20 The hygiene and the microflora hypotheses provide a groundwork for understanding the role of environmental factors in the aetiology of coeliac disease.21 These are supported by some studies on coeliac disease.10,22

It has been shown that coeliac disease is more prevalent among school children in a part of Finland where the socio-economic status is higher than in a comparable population in the adjacent Russian Karelia.10 However, a study from southeast England showed that belonging to a low socio-economic class increased the risk of coeliac disease.16 A Swedish biopsy-based study reported only a weak association with a low occupation status, while no association with education level was identified, despite having over 29 000 diagnosed coeliac disease cases.14 Also, other Swedish studies present some links between an increased risk of coeliac disease for children and their parents’ in a lower socio-economic strata.11,13,19,23

On the other hand, in another Swedish study that included all coeliac disease cases diagnosed between 1998 and 2003, an increased risk of childhood coeliac disease was shown to be strongly associated with higher income.13 Also, two studies in the United Kingdom showed that coeliac disease was more common in areas with a higher mean income.18,20 Similarly, a Dutch study, which did not include individual socio-economic factors, showed that coeliac disease was more common when those diagnosed during childhood lived in an area where the overall socio-economic status was higher than those diagnosed during adulthood.7

Even though studies have provided evidence on the association between socio-economic status and coeliac disease, these results are still contradicting, and they have not focused on screening-detected coeliac disease cases. The observed differences in coeliac disease prevalence might imply different rates of clinical diagnosis rather than a direct influence on the aetiology of coeliac disease. No investigation has yet studied a larger population of individuals diagnosed through screening.

The aim of our study was to examine whether there is a difference in coeliac disease prevalence in regard to parents’ education level and occupation, and whether this differs between screened and clinically diagnosed children at the age of 12 years.

2 | PARTICIPANTS AND METHODS

2.1 | Study material

For the current study, data from the Exploring the Iceberg of Celiacs in Sweden (ETICS) study was used. This study was a multi-centre cross-sectional school-based screening of coeliac disease among 12-year-olds in Sweden. ETICS was conducted during the school years 2005/2006 and 2009/2010 in five different regions.24 A total of 18 325 children were invited, of whom 13 279 children participated. A total of 100 children already had a diagnosis of coeliac disease through clinical care before the study started, and an additional 242 children were diagnosed with coeliac disease following the screening.4,24

At the time of the screening, and before the result of the blood sample were known, parents or other legal guardians of the participating children were asked to respond to a questionnaire. The questionnaire was sent to their home with two reminders, and a prepaid envelope addressed to the study administration. From this questionnaire, we used responses from the parents about their current labour market status, their current or most recent occupation, and their education level. In total, 11 239 (85%) of 13 279 parents in the ETICS study responded to the questionnaire.

The Regional Ethical Review Board of Umeå University approved the ETICS study.

2.2 | The questionnaire

Socio-economic status was defined based on three questions. The first question measured education level with five alternatives: <9 years at school, finished primary school, which corresponds to 9 years of school, finished upper secondary school, which corresponds to 12 years of school, at least 1 year of education after upper secondary school and university diploma. The second question asked about the parents’ labour market status with the following response alternatives: currently employed, self-employed, student, unemployed more or <6 months, working from home, parental leave and retired (either early-retired or age-retired). The third question asked the respondent to specify with words their current or most recent occupation. A socio-economic classification was obtained from these answers based on the socio-economic classification system defined by Statistics Sweden in 1982,25 both...
for each parent individually and for the highest classification between them. Codes for occupations were divided into the following groups: students 1-3, manual workers 11, 12, 21, 22 and 86-89, non-manual workers with low educational demand 33-36, 76, 77 and 79, non-manual workers with intermediate educational demand 46, and non-manual workers with high educational demand 56, 57, 60 and 78. The highest parental occupation of the child’s parents was chosen according to the instructions from Statistics Sweden.

|                          | Clinical CD (n = 88) | Screened CD (n = 231) | No CD (n = 10 710) |
|--------------------------|----------------------|-----------------------|--------------------|
| **Participants (n = 11 029)** |                      |                       |                    |
| Boys (n = 5608)          | 30 34                | 101 44                | 5477 51            |
| Girls (n = 5421)         | 58 66                | 130 56                | 5233 49            |
| **Mother’s occupation (n = 10 189)** |                      |                       |                    |
| Student (n = 424)        | 6 7.1                | 5 2.3                 | 413 4.2            |
| Manual worker (n = 3063) | 31 36                | 56 26                 | 2976 31            |
| Non-manual worker with low educational demand (n = 1923) | 15 18               | 49 23                 | 1859 19            |
| Non-manual worker with intermediate educational demand (n = 2939) | 22 26               | 56 26                 | 2861 29            |
| Non-manual worker with high educational demand (n = 1840) | 11 13               | 51 24                 | 1778 18            |
| **Household occupation (n = 10 420)** |                      |                       |                    |
| Student (n = 115)        | 0 0                  | 1 0.5                 | 114 1.1            |
| Manual worker (n = 2331) | 26 30                | 39 18                 | 2266 22            |
| Non-manual worker with low educational demand (n = 2317) | 16 19               | 51 23                 | 2250 22            |
| Non-manual worker with intermediate educational demand (n = 2402) | 19 22               | 50 23                 | 2333 23            |
| Non-manual worker with high educational demand (n = 3255) | 25 29               | 78 36                 | 3152 31            |
| **Mother’s educational level (n = 10 597)** |                      |                       |                    |
| Less than 9 y at school (n = 180) | 1 1.1               | 1 0.5                 | 178 1.7            |
| Primary school (n = 739) | 9 10                 | 11 5.0                | 719 7.0            |
| College (n = 3098)       | 21 24                | 76 35                 | 3001 29            |
| At least 1 y of education after college (n = 1941) | 16 18               | 36 17                 | 1889 18            |
| University diploma (n = 4639) | 40 46               | 94 43                 | 4505 44            |
| **Household educational level (n = 10 770)** |                      |                       |                    |
| Less than 9 y at school (n = 97) | 0 0                  | 1 0.5                 | 96 0.9             |
| Primary school (n = 419) | 6 6.8                | 8 3.6                 | 405 3.9            |
| College (n = 2844)       | 22 25                | 57 26                 | 2765 26            |
| At least 1 y of education after college (n = 1935) | 16 18               | 42 19                 | 1877 18            |
| University diploma (n = 5475) | 44 50               | 113 51                | 5318 51            |

**TABLE 1** Characteristics of the population divided into coeliac disease (CD) groups.
2.3 | Statistical analysis

Descriptive statistics are presented using frequency tables, cross-tabulations, and mean and median values. Associations between coeliac disease prevalence and socio-economic factors were analysed with prevalence ratios. In our analyses, we included children who had a coeliac disease diagnosis either before, referred to as clinical coeliac disease, or during the ETICS screening study, referred to as screened coeliac disease, or had a blood sample that did not indicate presence of coeliac disease, referred to as no coeliac disease. We also combined the first two groups into any coeliac disease to compare with no coeliac disease. In our analyses, the categories of manual worker and non-manual worker with low educational demand were combined and referred to as low-skilled workers, while the other categories for non-manual workers were combined and referred to as high-skilled workers. Furthermore, education level was divided into no university degree and university degree. The category of students was excluded in the analyses because the group had mixed education levels and different occupational backgrounds.

Statistical significance was defined at the 5% level. Microsoft Access was used for data handling. Stata 13.1 (StataCorp LP) was used for descriptive statistics. Prevalence ratios were calculated with WinPepi 11.65, including results for boys and girls separately, using the traditional log-transformation method to estimate confidence intervals.  

3 | RESULTS

There were 11 029 parents who responded to the questionnaire and whose child belonged to one of the three groups: clinically diagnosed, screening diagnosed or no coeliac disease. We excluded responses to the questionnaire from 161 parents to children who had no previous coeliac disease diagnosis and who did not provide a blood sample and 49 parents to children who were referred to a biopsy due to positive serology without having a confirmed coeliac disease diagnosis.

In both coeliac disease groups, there was a higher proportion of girls than boys with a coeliac disease diagnosis (Table 1). A similar observation was made in a previous article from the ETICS study. The relationship between occupation level and education and coeliac disease diagnosis is also presented in Table 1.

There were no statistically significant relationships between occupation and coeliac disease when we analysed the data for either of the coeliac disease groups in comparison with children with no coeliac disease, regardless of whether we used household or mother’s occupation (Table 2). Furthermore, there was no statistically significant relationship between any coeliac disease, whether screening-detected or clinically diagnosed, and any of the socio-economic measures (Tables 2 and 3). There was a numerical indication that those with lower socio-economic status were often diagnosed clinically, while screening-detected coeliac disease was common if parents had a higher socio-economic status. Also, for education level, there were no statistically significant relationships with the different coeliac disease groups (Table 3). The pattern for the prevalence ratios was similar as for occupation with estimates showing an even lower effect with prevalence ratios being closer to 1.

When the results were calculated for boys and girls separately, we found no statistical significance for either occupation or education (Tables 4 and 5). However, it was more common to have clinically diagnosed coeliac disease among boys whose parents had a higher occupation, as well as a longer education, while the opposite was observed for girls. For children who were diagnosed with coeliac disease through the ETICS study, there was a non-significant increased risk for coeliac disease for girls whose parents had high-skilled worker as the highest occupation.

4 | DISCUSSION

This study of 10 819 parents whose children had a coeliac disease diagnosis either clinically or through screening found no evidence for any statistically significant relationships between occupation and education and coeliac disease. However, there was a numerical

| Household occupation | Low-skilled workers | High-skilled workers | Prevalence ratio (confidence interval) |
|----------------------|---------------------|----------------------|--------------------------------------|
| Clinical CD          | 42 49               | 44 51                | 1.16 (0.76-1.76)                     |
| Screened CD          | 90 41               | 128 59               | 0.86 (0.66-1.12)                     |
| Any CD               | 132 43              | 172 57               | 0.93 (0.75-1.17)                     |
| No CD                | 4516 45             | 5485 55              | 1                                    |

| Mother’s occupation  | Low-skilled workers | High-skilled workers | Prevalence ratio (confidence interval) |
|----------------------|---------------------|----------------------|--------------------------------------|
| Clinical CD          | 46 58               | 33 42                | 1.33 (0.85-2.08)                     |
| Screened CD          | 105 50              | 107 50               | 0.94 (0.72-1.23)                     |
| Any CD               | 151 52              | 140 48               | 1.03 (0.82-1.30)                     |
| No CD                | 4835 51             | 4639 49              | 1                                    |
### TABLE 3  Association between coeliac disease (CD) and education

|                     | No university degree | University degree | Prevalence ratio (confidence interval) |
|---------------------|----------------------|------------------|----------------------------------------|
|                     | n        | %    | n        | %    |                                  |
| **Household education** |                      |                  |                                        |
| Clinical CD         | 44   | 50  | 44   | 50  | 1.03 (0.68-1.57)                 |
| Screened CD         | 108  | 49  | 113  | 51  | 0.99 (0.76-1.28)                 |
| Any CD              | 152  | 49  | 157  | 51  | 1.00 (0.80-1.25)                 |
| No CD               | 5143 | 49  | 5318 | 51  | 1                             |
| **Mother’s education** |                      |                  |                                        |
| Clinical CD         | 47   | 54  | 40   | 46  | 0.92 (0.60-1.39)                 |
| Screened CD         | 124  | 57  | 94   | 43  | 1.03 (0.79-1.34)                 |
| Any CD              | 171  | 56  | 134  | 44  | 0.99 (0.80-1.24)                 |
| No CD               | 5787 | 56  | 4505 | 44  | 1                             |

### TABLE 4  Association between coeliac disease (CD) and occupation, divided according to the sex of the child

|                     | Boys   | Girls   |                     |                     |
|---------------------|--------|---------|---------------------|---------------------|
|                     | Low-skilled workers | High-skilled workers | Low-skilled workers | High-skilled workers |
|                     | n        | %    | n        | %    | n        | %    | n        | %    |
| **Household occupation** |                      |                  |                      |                  |
| Clinical CD         | 11   | 38  | 18   | 62  | 0.74 (0.35-1.57) | 0.60 (0.28-1.25) | 1.45 (0.94-2.23) | 31   | 54  | 26   | 46  | 0.74 (0.35-1.57) | 0.60 (0.28-1.25) | 1.45 (0.94-2.23) |
| Screened CD         | 43   | 46  | 50   | 54  | 1.04 (0.69-1.56) | 1.14 (0.76-1.69) | 0.89 (0.57-1.41) | 47   | 38  | 78   | 62  | 0.74 (0.52-1.06) | 0.89 (0.57-1.41) | 1.06 (0.79-1.34) |
| Any CD              | 54   | 44  | 68   | 56  | 0.96 (0.68-1.37) | 0.98 (0.69-1.38) | 1.02 (0.78-1.41) | 78   | 43  | 104  | 57  | 0.92 (0.69-1.22) | 0.98 (0.69-1.38) | 1.02 (0.78-1.41) |
| No CD               | 2306 | 45  | 2793 | 55  | 1                             | 1                          | 1                          | 2210 | 45  | 2692 | 55  | 1                             | 1                          | 1                          |
| **Mother’s occupation** |                      |                  |                      |                  |
| Clinical CD         | 12   | 46  | 14   | 54  | 0.84 (0.39-1.81) | 0.55 (0.26-1.15) | 1.37 (0.82-2.30) | 34   | 64  | 19   | 36  | 1.68 (0.96-2.93) | 1.37 (0.82-2.30) | 1.18 (0.70-1.99) |
| Screened CD         | 49   | 54  | 41   | 46  | 1.16 (0.77-1.75) | 1.14 (0.76-1.69) | 0.99 (0.64-1.28) | 56   | 46  | 66   | 54  | 0.89 (0.63-1.26) | 1.14 (0.76-1.69) | 0.99 (0.64-1.28) |
| Any CD              | 61   | 53  | 55   | 47  | 1.08 (0.75-1.55) | 0.98 (0.69-1.38) | 1.00 (0.79-1.41) | 90   | 51  | 85   | 49  | 1.00 (0.78-1.28) | 0.98 (0.69-1.38) | 1.00 (0.79-1.41) |
| No CD               | 2441 | 51  | 2381 | 49  | 1                             | 1                          | 1                          | 2394 | 51  | 2258 | 49  | 1                             | 1                          | 1                          |

### TABLE 5  Association between coeliac disease (CD) and education, divided according to the sex of the child

|                     | Boys   | Girls   |                     |                     |
|---------------------|--------|---------|---------------------|---------------------|
|                     | Low-skilled workers | High-skilled workers | Low-skilled workers | High-skilled workers |
|                     | n        | %    | n        | %    | n        | %    | n        | %    |
| **Household education** |                      |                  |                      |                  |
| Clinical CD         | 11   | 37  | 19   | 63  | 0.60 (0.28-1.25) | 0.55 (0.26-1.15) | 1.37 (0.82-2.30) | 33   | 57  | 25   | 43  | 1.37 (0.82-2.30) | 1.18 (0.70-1.99) |
| Screened CD         | 50   | 53  | 45   | 47  | 1.14 (0.76-1.69) | 1.05 (0.70-1.58) | 1.01 (0.71-1.43) | 58   | 46  | 68   | 54  | 0.89 (0.63-1.26) | 1.01 (0.71-1.43) |
| Any CD              | 61   | 49  | 64   | 51  | 0.98 (0.69-1.38) | 0.90 (0.64-1.28) | 1.06 (0.79-1.41) | 91   | 49  | 93   | 51  | 1.02 (0.77-1.36) | 1.06 (0.79-1.41) |
| No CD               | 2707 | 49  | 2776 | 51  | 1                             | 1                          | 1                          | 2497 | 49  | 2606 | 51  | 1                             | 1                          | 1                          |
| **Mother’s education** |                      |                  |                      |                  |
| Clinical CD         | 12   | 41  | 17   | 59  | 0.55 (0.26-1.15) | 0.55 (0.26-1.15) | 1.18 (0.70-1.99) | 35   | 60  | 23   | 40  | 1.18 (0.70-1.99) | 1.18 (0.70-1.99) | 1.18 (0.70-1.99) |
| Screened CD         | 54   | 57  | 40   | 43  | 1.05 (0.70-1.58) | 1.05 (0.70-1.58) | 1.05 (0.70-1.58) | 70   | 56  | 54   | 44  | 1.05 (0.70-1.58) | 1.05 (0.70-1.58) | 1.05 (0.70-1.58) |
| Any CD              | 66   | 54  | 57   | 46  | 0.90 (0.64-1.28) | 0.90 (0.64-1.28) | 0.90 (0.64-1.28) | 105  | 57  | 77   | 43  | 0.90 (0.64-1.28) | 0.90 (0.64-1.28) | 0.90 (0.64-1.28) |
| No CD               | 2961 | 56  | 2306 | 44  | 1                             | 1                          | 1                          | 2826 | 56  | 2199 | 44  | 1                             | 1                          | 1                          |
indication that lower socio-economic status was related to an increased chance of being diagnosed clinically, while diagnosis through screening was more common if the parents had a higher socio-economic status. Despite inviting over 18,000 children to the study, we had limited number of children who were diagnosed with coeliac disease. Therefore, we remain cautious when presenting conclusions about the relationship between socio-economic status and the risk of having coeliac disease, either clinically or by screening.

Our study was in line with previous studies that could not provide statistical evidence for an association between socio-economic status and the prevalence of coeliac disease. The observed numerical, but not statistically significant indication that lower socio-economic status was related to an increased risk of being diagnosed clinically follows the same pattern as seen in previous Swedish studies.\textsuperscript{11,13,19,23} However, we cannot relate the results for screening-detected cases to previous studies in which they were clinically diagnosed. Some previous studies attributed health disparities according to socio-economic status to differences in help-seeking behaviours.\textsuperscript{27,28} Persons from deprived areas tend to be less likely to seek medical care and are potentially less likely to undergo coeliac disease testing. Thus potentially explaining the higher coeliac disease incidence in areas with higher socio-economic status in the British studies.\textsuperscript{18,20} However, our findings did not support this stance as we observed a higher, although not significant, coeliac disease prevalence for the group with lower socio-economic status in the clinical cases.

Our study does not promote efforts for case finding related to parental occupation or education. However, further research on socio-economic conditions and coeliac disease in populations with larger welfare gradients than Sweden and with privatised health care may be more suited to identify this association.

The hygiene and the microflora hypotheses provide a common explanation for the potential role of socio-economic status in coeliac disease aetiology.\textsuperscript{21} In our study, we included all cases of coeliac disease, both clinical and screening-detected, thus eliminating the variations in coeliac disease risk attributed to differences in clinical diagnosis. We found no association between any coeliac disease and any of the socio-economic measures. These findings suggest that socio-economic status does not influence the risk of developing coeliac disease.

To our knowledge, ours is the first study to assess the relationship between socio-economic status and coeliac disease risk with both clinically and screening-detected coeliac disease patients. The diagnosis of coeliac disease was biopsy verified for both clinically and screening-detected coeliac disease cases. A limitation of our study was that the geographical areas were not randomly chosen and they only covered around 10% of Swedish children. Consequently, the proportion of clinical cases might differ to other regions. However, a previous ETICS publication concluded that participating areas were representative of the whole population regarding socio-economic status.\textsuperscript{24} We therefore expect any differences to have negligible impact on our conclusions.

Almost 40% of the children invited to the ETICS study did not respond to the questionnaire. Participation might be high among already diagnosed children, while it is more unlikely among other children as they lack knowledge about coeliac disease. Moreover, 86% of the parents to children with clinically diagnosed coeliac disease answered the questionnaire, implying that results for them were representative. Previous reports show similarities between participants and non-participants in ETICS.\textsuperscript{5,24} It is therefore likely that non-participation had a negligible effect on the prevalence’s for children without a coeliac disease diagnosis prior to our study. The measurements of parental education and occupation might affect our results because these were self-reported. However, parents reported this information in a standard way. The occupation classifications are from a well worked definition by Statistics Sweden,\textsuperscript{25} making it a reliable tool to use.

## 5 | CONCLUSION

There was no apparent relationship between coeliac disease and socio-economic status. However, there were some indications that children of a lower socio-economic background are more frequently being diagnosed clinically and that children of a higher socio-economic background to a greater extent have an undiagnosed coeliac disease later detected in the screening. Despite a large study sample, we could not confirm a dependency between socio-economic status and the risk of having coeliac disease.

## ACKNOWLEDGEMENTS

We would like to thank all participating children and their families. Furthermore, we would like to thank the all the school personnel and the ETICS research team for their contributions.

## CONFLICT OF INTEREST

The authors report no conflicts of interest.

## ORCID

Fredrik Norström [https://orcid.org/0000-0002-0457-2175](https://orcid.org/0000-0002-0457-2175)
Fredinah Namatovu [https://orcid.org/0000-0001-5471-9043](https://orcid.org/0000-0001-5471-9043)
Annelie Carlsson [https://orcid.org/0000-0002-5608-3437](https://orcid.org/0000-0002-5608-3437)
Lotta Högb erg [https://orcid.org/0000-0001-5966-9241](https://orcid.org/0000-0001-5966-9241)
Anneli Ivarsson [https://orcid.org/0000-0001-8944-2558](https://orcid.org/0000-0001-8944-2558)
Anna Mylèus [https://orcid.org/0000-0003-2478-9598](https://orcid.org/0000-0003-2478-9598)

## REFERENCES

1. Lebwohl B, Sanders DS, Green PHR. Coeliac disease. Lancet. 2018;391:70-81.
2. Dubé C, Rostom A, Sy R, et al. The prevalence of celiac disease in average-risk and at-risk Western European populations: a systematic review. Gastroenterology. 2005;128:557-567.
3. Mustalahti K, Catassi C, Reunanen A, et al. The prevalence of ce liac disease in Europe: results of a centralized, international mass screening project. Ann Med. 2010;42:587-595.
4. Myléus A, Ivarsson A, Webb C, et al. Celiac disease revealed in 3% of Swedish 12-year-olds born during an epidemic. *J Pediatr Gastroenterol Nutr.* 2009;49:170-176.

5. Fasano A, Catassi C. Current approaches to diagnosis and treatment of celiac disease: an evolving spectrum. *Gastroenterology.* 2000;120:636-651.

6. Lindfors K, Lin J, Lee HS, et al. Metagenomics of the faecal virome indicate a cumulative effect of enterovirus and gluten amount on the risk of coeliac disease autoimmunity in genetically at risk children: the TEDDY study. *Gut.* 2020;69:1416-1422.

7. Ludvigsson JF, Lebwohl B. Three papers indicate that amount of gluten play a role for celiac disease - But only a minor role. *Acta Paediatr.* 2020;109:8-10.

8. Silano M, Agostoni C, Sanz Y, Guandalini S. Infant feeding and risk of developing celiac disease: a systematic review. *BMJ Open.* 2016;6:e009163.

9. Burger JP, Roovers EA, Drenth JP, Meijer JW, Wahab PJ. Rising incidence of celiac disease in the Netherlands; an analysis of temporal trends from 1995 to 2010. *Scand J Gastroenterol.* 2014;49:933-941.

10. Kondrashova A, Mustalahti K, Kaukinen K, et al. Lower economic status and inferior hygienic environment may protect against celiac disease. *Ann Med.* 2008;40:223-231.

11. Ludvigsson JF. Socio-economic characteristics in children with celiac disease. *Acta Paediatr.* 2005;94:107-113.

12. Namatovu F, Olsson C, Lindkvist M, et al. Maternal and perinatal conditions and the risk of developing celiac disease during childhood. *BMC Pediatr.* 2016;16:77.

13. Namatovu F, Strömgren M, Ivarsson A, et al. Neighborhood conditions and celiac disease risk among children in Sweden. *Scand J Public Health.* 2014;42:572-580.

14. Olen O, Bihagen E, Rasmussen F, Ludvigsson JF. Socioeconomic position and education in patients with celiac disease. *Dig Liver Dis.* 2012;44:471-476.

15. Olsson C, Stenlund H, Hörnell A, Hernell O, Ivarsson A. Regional variation in celiac disease risk within Sweden revealed by the nationwide prospective incidence register. *Acta Paediatr.* 2009;98:337-342.

16. Roberts SE, Williams JG, Meddings D, Davidson R, Goldacre MJ. Perinatal risk factors and celiac disease in children and young adults: a record linkage study. *Aliment Pharmacol Ther.* 2009;29:222-231.

17. West J, Fleming KM, Tata LJ, Card TR, Crooks CJ. Incidence and prevalence of celiac disease and dermatitis herpetiformis in the UK over two decades: population-based study. *Am J Gastroenterol.* 2014;109:757-768.

18. Whyte LA, Kotecha S, Watkins WJ, Jenkins HR. Celiac disease is more common in children with high socio-economic status. *Acta Paediatr.* 2014;103:289-294.

19. Zingone F, West J, Crooks CJ, et al. Socioeconomic variation in the incidence of childhood coeliac disease in the UK. *Arch Dis Child.* 2015;100:466-473.

20. Bach JF. The hygiene hypothesis in autoimmunity: the role of pathogens and commensals. *Nat Rev Immunol.* 2018;18:105-120.

21. Braveman P. Health disparities and health equity: concepts and measurement. *Annu Rev Public Health.* 2006;27:167-194.

22. Kozyrskyj AL, Dahl ME, Chateau DG, Mazowita GB, Klassen TP, Law BJ. Evidence-based prescribing of antibiotics for children: role of socioeconomic status and physician characteristics. *Can Med Assoc J.* 2004;171:139-145.

How to cite this article: Norström F, Namatovu F, Carlsson A, Högberg L, Ivarsson A, Myléus A. Family socio-economic status and childhood coeliac disease seem to be unrelated—A cross-sectional screening study. *Acta Paediatr.* 2020;00:1-7. https://doi.org/10.1111/apa.15562