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Associations between having breakfast and reading literacy achievement among Nordic primary school students

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ABSTRACT

Having breakfast is associated with improved diet quality, cognitive- and academic performance and can therefore positively impact learning and health, although the impact on reading literacy is unknown in the Nordic countries. The aim of this study was to assess the association between having breakfast often versus rarely and reading literacy achievement based on Progress in International Reading Literacy Study (PIRLS) from 2016. The sample consisted of Danish (N = 3508), Finnish (N = 4896), Norwegian (N = 4232) and Swedish (N = 4525) students, 10–11 years old. Students self-reported their frequency of having breakfast. Linear regression analysis (adjusted for socioeconomic status and gender) showed that those who often vs. rarely had breakfast achieved a higher reading literacy score. The results suggest that having breakfast may be important for reading literacy achievement even after adjusting for socioeconomic status. This potential relationship between breakfast intake and students' academic achievement should be given priority for further research and practice as breakfast is a modifiable factor that can be both improved and be intervened on.

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Introduction

Reading is a basic prerequisite for learning and for acquisition of knowledge (McLauhlin et al., 2005; Mullis & Martin, 2015; Ogino et al., 2017; Schröter & Bar-Kochva, 2019). A high level of reading skills is needed in order to function effectively in the information society, for participation in the working life and to succeed in economic and personal adult life (Eyre, 2003; OECD, 2017). A challenge in this regard is the disparities in learning opportunities students with health problems and different socio-economic backgrounds have (Basch, 2011; Chmielewski, 2019). Students' socio-economic background is linked to their parents' education and income level, and differences in socioeconomic status (SES) can influence their health status and potential for achieving other objectives in life, such as education and employment (Whitehead & Dahlgren, 2006). Differences in SES and social inequalities in health are important public health challenges in low-, middle- and high-income countries (World Health

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Organization, 2018), and remains as public health challenges in the egalitarian welfare-driven Nordic countries known as the welfare paradox (Fosse & Helgesen, 2019). During schooling, differences in SES are demonstrated through an “achievement gap” i.e. students with health disparities and low SES tend to score poorer in academic achievement tests (Basch, 2011; Chmielewski, 2019). Even in Norway and Sweden, as examples of countries with high enrolments rates in primary school, there is an increase in the achievement gap between students with higher and lower SES (Chmielewski, 2019). It is therefore important to find possible solutions to reduce this achievement gap and provide students with equal learning opportunities (Chmielewski, 2019).

Breakfast habits have gained attention among researchers and in the public health area, as one of several factors that may impact academic performance (Adolphus et al., 2013; Cohen, Hecht, McLoughlin, Turner, & Schwartz, 2021; Lundqvist, Vogel, & Levin, 2019; Rani, Dharaiya, & Singh, 2020). The Health Behaviour in School-aged Children (HBSC) study showed that while the rate of daily consumption of breakfast remained stable among students in Denmark, Finland and Sweden from 2002 to 2010, a decrease was observed among Norwegian students (Lazzeri et al., 2016). Nearly 70% of students in Denmark, 61% in Finland, 64% in Norway and 70% of students in Sweden had breakfast daily (Lazzeri et al., 2016). Thus, promoting breakfast remains important for all Nordic countries. The HBSC study also showed that there may be differences in breakfast habits among boys and girls in the Nordic countries: boys had daily breakfast more often than girls (Lazzeri et al., 2016).

Breakfast and learning

A positive association of having breakfast and academic performance has been suggested in the scientific literature. Adolphus et al. (2021) showed that having cereals for breakfast versus having no breakfast had positive acute effect on cognitive function in a sample of predominantly lower socio-economic status students in the UK. Having breakfast has also been associated with lower self-reported tiredness and hunger, positive feelings of alertness, satiety and improved cognitive function measured by different cognitive function tests among students in the UK (Cooper, Bandelow, & Nevill, 2011; Defeyter & Russo, 2013). Burrows, Goldman, Olson, Byrne, and Coventry (2017) documented that regular consumption of breakfast and fruits was associated with lower odds of learning difficulties in reading and writing, whereas a high intake of sugar-sweetened beverages was associated with lower test scores in reading among Australian students (Burrows et al., 2017). Ptomey et al. (2016) showed that having breakfast versus skipping and having breakfast including whole grains were associated with improved scores in reading comprehension in a US student sample, indicating that both having breakfast and quality of the content might be of importance. Furthermore, the school breakfast program in the US has been associated with improved scores in reading and mathematics and higher attendance rate particularly when breakfast was offered for free-for-all students (Bartfeld, Berger, Men, & Chen, 2019). Despite its potential, a review by Cohen et al. (2021) showed mixed results on the impact of free breakfast on academic performance, potentially related to low uptake of breakfast provided at school (Cohen et al., 2021). Still, many students in Australia, the UK and the US receive breakfast at school through school breakfast programs or clubs

(Hoyland, McWilliams, Duff, & Walton, 2012; MacDonald, 2019; U.S. Department of Agriculture Food and Nutrition Service, 2017), while there is no national provision of school breakfast in Nordic primary schools (Dahl & Jensberg, 2011). It may therefore be difficult to extrapolate the international research to a Nordic setting.

Having breakfast has been associated with higher achievement in mathematics and science and higher self-reported academic achievement (Lien, 2007; Stea & Torstveit, 2014; Vik, Nilsen, & N. C., 2022) among Norwegian students. Vik et al. (2022) also showed that skipping of breakfast explained one-third of the decline in science achievement and more than half of the decline in mathematics achievement among Norwegian students from 2015 to 2019. Furthermore, having breakfast has, among Norwegian students, been associated with decreased odds for self-reported writing and reading difficulties and mathematical difficulties (Øverby, Lüdemann, & Høigaard, 2013). A Norwegian pilot study showed that serving a free school breakfast for four months increased boys' school contentment, and some teachers reported improved school attention and social behaviour (Ask, Hernes, Aarek, Johannessen, & Haugen, 2006). However, no effect was found for self-reported school performance (Ask et al., 2006). Overall, some associations for breakfast and academic performance have been documented, however these are heavily based on self-reported academic performance. There is a lack of studies investigating having breakfast and reading achievement in the Nordic countries (Dahl & Jensberg, 2011) and further research is needed. Therefore, this current study adds to this research gap by investigating a Nordic subsample of Danish, Finnish, Swedish and Norwegian students in a large international study, Progress in International Reading Literacy Study (PIRLS), assessing having breakfast (self-reported) and associations with reading literacy through a comprehensive standardised reading test.

PIRLS 2016

PIRLS, the Progress in International Reading Literacy Study conducted by the IEA (International Association for the Evaluation of Educational Achievement), is an international study that every 5th year assesses trends in reading literacy. The study is conducted among 4th graders who are usually 10–11 years old. At this age, students typically shift from learning how to read towards reading to learn in other subjects in school (Mullis & Martin, 2015).

The reading literacy test is designed to measure processes of comprehension: retrieving information, making inferences, interpreting, and evaluating textual content, thereby providing the students to demonstrate a range of reading-related abilities and skills (Mullis & Martin, 2015). In PIRLS, reading literacy is defined as:

... the ability to understand and use those written language forms required by society and/or valued by the individual. Readers can construct meaning from texts in a variety of forms. They read to learn, to participate in communities of readers in school and everyday life, and for enjoyment” (Mullis & Martin, 2015 (p.12, lines 8.12)).

Based on the overall results from PIRLS 2016, a total of 1 out of 4 students reported that they often arrived at school feeling hungry (Mullis et al., 2017). Furthermore, reading achievement was lower among children that often arrive in school feeling hungry

compared to children who never felt hungry when arriving in school. These results are based on all the participating countries and does not provide information about the Nordic countries specifically (Mullis et al., 2017).

The rationale for comparing the Nordic countries besides their geographical proximity, is that they have a common a comparable educational system with national regulations, free compulsory basic education, the majority of students attend public schools, high enrolment rates in early childhood education, a highly developed labour market, a highly educated population, similar culture and language and similar challenges related to social inequalities in health (Fosse & Helgesen, 2019; Mejding, Neubert, & Larsen, 2017; Mullis et al., 2017; Nordic Co-operation, 2020a; 2020b; Statistics Denmark, 2014; Statistics Norway, 2021).

Aim

The aim of the current study was to explore the association between having breakfast and reading literacy among 10–11-year-old students in Denmark, Finland, Norway, and Sweden by secondary analysis using PIRLS 2016 data. We hypothesised that students who reported to often have breakfast would be more likely to achieve a higher score in reading literacy compared to students who reported to rarely have breakfast.

Materials and methods

The materials and methods in PIRLS were completed in collaboration between national research coordinators, Statistics Canada, experts, reading specialists and IEA specialists (Martin, Mullis, & Hooper, 2017; Mullis & Martin, 2015). Students who participated in PIRLS responded to a reading literacy test and a context questionnaire, and their parents/caretakers answered on a home context questionnaire. The complexity of the sampling design in PIRLS and measurement of reading literacy requires use of estimated weights and estimated population size. A short description of the reading literacy test and included variables for this current paper is provided below, please visit the international PIRLS report (Martin et al., 2017) for a more detailed methods outline.

PIRLS use a 2-stage sampling scheme, with random selection but different sampling probabilities depending on the characteristics of the school (see Martin et al. (2017) for details on the sampling probabilities). In the first sampling stage, schools were randomly selected. In the second sampling stage, a random selection of class(es) within the school were drawn. The sampling design using sampling weights finally produce results that are representative for the population (Martin et al., 2017).

The reading literacy test in PIRLS consisted of 16 booklets that was distributed systematically and each student responded to a subset of the assessment items (Martin et al., 2017). PIRLS uses a scaling method based on Item Response Theory (IRT), that, by using observed and unobserved values, can assign each student a position on the overall reading literacy scale (Martin et al., 2017). When calculating student overall performance, PIRLS uses estimated weights that take into account the sampling scheme (i.e. different selection probabilities), non-response and the estimated population size.

The target sample for PIRLS 2016 was, for most countries, students in the 4th year of formal schooling with a recommended lower age limit on 9.5 years old. However,

children's age in the 4th year varies for some countries due to different structures in practices and policies (Mullis et al., 2017). In Norway, 5th graders were age-comparable to the other Nordic 4th graders, and we therefore use data from Norwegian 5th graders in this present paper.

Instruments

For the reading literacy test, each of the 16 booklets in PIRLS consisted of two assessment blocks with a text and a combination of multiple-choice questions and open-ended questions following the text. Students responded to a context questionnaire after the reading test (Martin et al., 2017). The student context questionnaire was designed to measure student's home and school lives. In this questionnaire, children were asked "How often do you eat breakfast on school days?" with the response alternatives "every day", "most days", "sometimes", "almost never" and "never".

Parents/caregivers also responded to a home context questionnaire. A "Home Resources for Learning" scale consisting of five different items from the student and parent questionnaires was developed by PIRLS and applied as proxy for SES in this current paper (Martin et al., 2017). The included items in the SES scale were, from the parent questionnaire, number of books in the home, number of children's books in the home (both without e-books), highest level of education of both parents/caregivers, highest level of occupation among parents/caregivers and, from the student questionnaire, number of home study supports which included access to internet and their own room. For a technical description as to how the scale was constructed and validated, please see Chapter 14 in the "Methods and Procedures in PIRLS 2016" report (Martin et al., 2017).

Analysis

All analyses in this current paper were carried out, by using IDB Analyser version 4.0.42.0. This program has been developed to analyse data from IEA surveys (International Association for the Evaluation of Educational Achievement, n.a), and IBM SPSS Statistics version 25. THE IDB Analyser takes into account the sampling design, estimated weights and estimated population size (Wagemaker, 2020).

Having breakfast and student gender were measured as categorical variables, while reading literacy and the index for SES were measured as continuous variables. Having breakfast was dichotomised as 1 = often including "every day" and "most days" and 0 = rarely, including "sometimes", "almost never" and "never". This is a common way to assess having breakfast: comparing having breakfast rarely versus often, intake versus omission or skipping breakfast (Lundqvist et al., 2019). Gender was coded 0 for girls and 1 for boys. The international SES scale was calculated by PIRLS for all participating countries and had an international average on 10 and a standard deviation of 2. The SES scale was based on over responses from over 85% of parents in Denmark, Finland and Norway and 70–85% of parents in Sweden (Martin et al., 2017). Reading literacy was reported on a scale ranging from 300 to 700 with an international centre-point at 500 and an SD of 100, where higher values indicate better reading literacy (Mullis, et al., 2017). Descriptive analyses are presented by weighted percentage in [Figure 1](#). We used

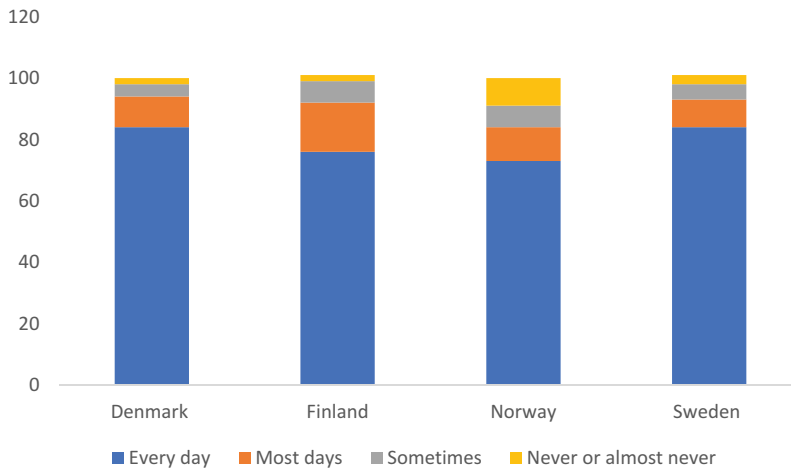


Figure 1. How often do you have breakfast on schooldays? Response pr country

Data are based on weighted percentage.

hierarchical linear regression to examine whether having breakfast was associated with student reading literacy score (dependent variable) adjusted for SES and gender as potential confounding factors. Main results from the regression are presented as regression coefficients with 95% confidence intervals and explained variance (R squared). The regression analysis is presented in three models. Model 1 presents the unadjusted analysis of having breakfast and reading literacy, model 2 includes model 1 adjusted for SES and model 3 includes model 2 adjusted for SES and gender. A sensitivity analysis was performed to check that the results were robust when analysing reading literacy achievement without grouping breakfast responses and adjusting for SES and gender (Data not shown).

Results

In [Table 1](#), sample characteristics are provided. The Nordic students scored above the average on the international SES scale and had comparable SES estimates ([Table 1](#)).

All the included Nordic countries scored above the international average for reading literacy score (500) with mean scores on 551, 570 and 562 for Danish, Finnish, Norwegian and Swedish students, respectively. Boys scored slightly lower than girls in all the Nordic countries ([Table 2](#)).

Table 1. Sample characteristics.

Country	N (17,161)	SES	Girls	Boys
	<i>Unweighted</i>	<i>Mean(95%CI)</i>	<i>Percentage(95%CI)</i>	
Denmark	3508	11.35 (11.25–11.45)	52 (50–54)	48 (46–50)
Finland	4896	11.20 (11.14–11.23)	51 (49–53)	49 (47–51)
Norway	4232	11.45 (11.37–11.53)	51 (49–53)	49 (47–51)
Sweden	4525	11.44 (11.34–11.54)	50 (48–52)	50 (48–52)

Weighted data for SES and boys and girls. SES Scale: international \pm average of 10 2 SD (Martin et al., 2017).

Table 2. Reading literacy score.

Country	All		Girls		Boys	
	Mean	95% CI	Mean	95%CI	Mean	95%CI
Denmark	551	547–555	556	551–561	545	540–550
Finland	570	566–573	579	575–583	560	556–564
Norway	562	557–566	572	567–577	551	545–556
Sweden	562	557–567	569	564–574	555	549–561

Weighted data. Mean country scores range from 320 (South Africa) to 581 (Russian Federation) (Mullis, Martin, Foy, & Hooper, 2017).

The descriptive data presented in [Figure 1](#) illustrate that most students had breakfast often. It was more common to have breakfast every day compared to most days, sometimes and never or almost never. More Norwegian students had breakfast “never or almost never” compared to Danish, Finnish and Swedish students. We also identified that there were no differences between girls and boys regarding having breakfast (Data not shown).

In [Table 3](#), unadjusted and adjusted estimates of differences in reading literacy according to the four response alternatives for breakfast are presented for each included Nordic country. Unadjusted analysis showed that students who had breakfast often vs rarely scored on average higher on the reading literacy scale by 36 points in Denmark, explaining 2% in the variance in reading literacy. Finnish, Norwegian, and Swedish students who had breakfast often vs rarely scored, respectively, 34, 20 and 39 points

Table 3. Differences in reading literacy according to self-reported having breakfast often versus rarely, unadjusted (Model 1) and adjusted for SES (Model 2) and SES and gender (Model 3), regression coefficients with \pm 95% CI and R squared.

	Model 1	Model 2	Model 3
Denmark			
Often breakfast	36 (26–46)	22 (12–32)	23 (13–33)
SES		16 (14–18)	16 (14–18)
Gender			–12 (–16(–6))
Constant	517 (507–527)	354 (330–378)	359 (335–383)
R squared	2%	14%	15%
Finland			
Often breakfast	34 (25–44)	24 (15–33)	22 (13–31)
SES		17 (15–19)	17 (15–19)
Gender			–19 (–23(–15))
Constant	538 (528–548)	353 (329–377)	364 (388–340)
R squared	2%	15%	17%
Norway			
Often breakfast	20 (12–28)	13 (6–20)	13 (6–20)
SES		15 (14–16)	15 (14–16)
Gender			–18 (–22(–14))
Constant	545 (537–553)	379 (359–399)	393 (374–412)
R squared	1%	13%	15%
Sweden			
Often breakfast	39 (28–50)	25 (16–34)	25 (16–34)
SES		16 (14–18)	16 (14–18)
Gender			–12 (–17(–7))
Constant	525 (515–536)	356 (336–376)	364 (343–385)
R squared	3%	17%	18%

Constant: Model 1: Breakfast coded 0 = rarely, 1 = often, Model 2: Adjusted for SES. Model 3: Adjusted for SES and gender. Gender coded 0 = girl, 1 = boy. Unstandardised coefficients and weighted data and R square were used for explained variance.

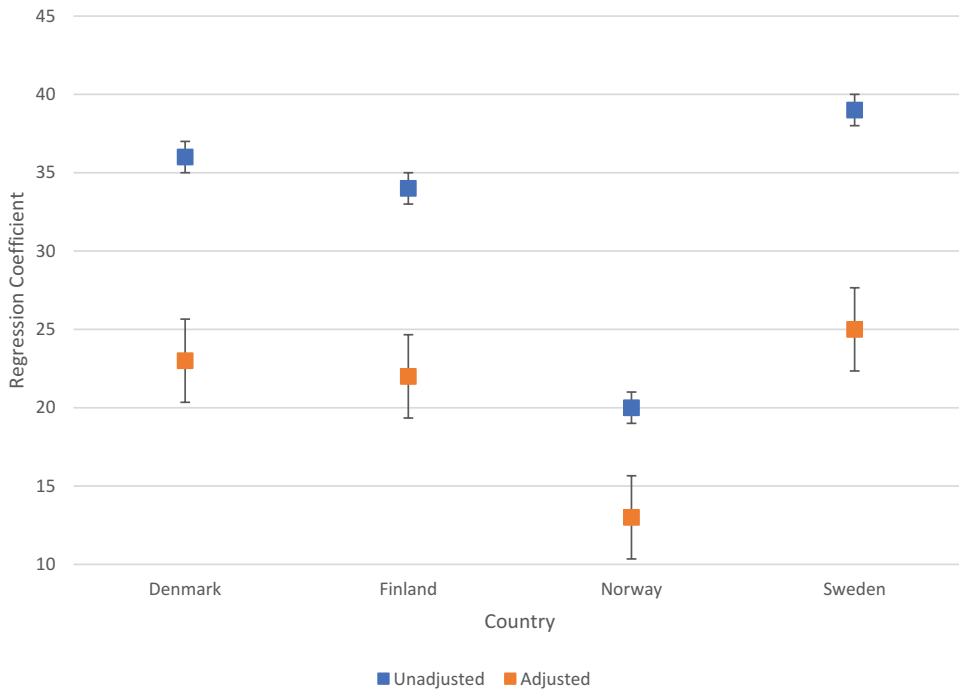


Figure 2. The association between having breakfast often vs rarely and reading literacy. Weighted data. Unadjusted = Model 1 and adjusted = Model 3. The error bars show 95% CI.

higher on average on the reading literacy score, explaining 2%, 1% and 3% of the variance in reading literacy. Students who often vs rarely had breakfast still, on average, achieved higher reading literacy score by 23 points in Denmark, 22 points in Finland, 13 points in Norway and 25 points in Sweden when adjusting for SES and gender. SES appears to be an important confounder, although having breakfast often was associated with higher reading literacy score even after adjusting for SES. The explained variance for the adjusted model (Model 3) was 15% in Denmark, 17% in Finland, 13% in Norway and 18% in Sweden (Table 3). Adjusting for gender did not change the estimates substantially. Figure 2 illustrates the association of having breakfast and reading literacy comparing the unadjusted and adjusted model. The same pattern of results was seen across all the Nordic countries, although a higher reading literacy score and a smaller association between having breakfast and reading literacy were observed among Norwegian students (Table 3).

Discussion

The findings of this study demonstrated that having breakfast often was associated with higher achievement in reading literacy, based on an objectively measured reading test among a large cross-sectional sample of Nordic primary school students. Having breakfast was associated with higher reading literacy score also after adjusting for SES. Our finding is in line with previous research showing an association between

having breakfast and reading (Ptomey et al., 2016) and other studies where outcome variables were academic performance, educational outcomes, mental health or learning difficulties (Burrows et al., 2017; Lien, 2007; Littlecott, Moore, Moore, Lyons, & Murphy, 2016; Øverby et al., 2013; Sampasa-Kanyinga & Hamilton, 2017; Stea & Torstveit, 2014).

Furthermore, the results showed that SES was more important for reading literacy than having breakfast. This was not surprising, as most of the students had breakfast often, with a slightly higher percentage consuming breakfast every day compared to results from the HSBC study (Lazzeri et al., 2016). We argue that the observed difference in reading literacy associated with having breakfast is still important as breakfast habits are something that can be improved and intervened on. The rationale for comparing the Nordic countries was that they were comparable in terms of education policy and practices, with high educational enrolment rate, highly educated people and similar challenges with social inequalities in health (Fosse & Helgesen, 2019; Mejding et al., 2017; Mullis, et al., 2017; Nordic Cooperation, 2020a; 2020b; Statistics Denmark, 2014; Statistics Norway, 2021). The finding that breakfast may be of importance for academic performance regardless of SES is also supported in a review by Adolphus et al. (2013), and in a recently published paper by Vik et al. (2022), which makes our results plausible. As having breakfast may be of importance for all students, policy makers may consider placing promotion of breakfast and breakfast provision on the school agenda.

Although the pilot-study from Norway providing a free school breakfast for 4 months, showed no effect on self-reported school performance, it showed a potential for breakfast provision to increase school contentment, school attention and social behaviour (Ask et al., 2006). This pilot study lacked an objective measure of school performance and breakfast was only provided for a short period of time (Ask et al., 2006). An example from the UK showed that breakfast provision at school provided an opportunity for students to have an enjoyable start of the school day, potentially making them feel more alert, increasing their social interaction and supporting them in developing favourable social skills (Graham, Russo, & Defeyter, 2015). This is also supported in Nordic examples when lunch was provided at school replacing packed meals. A free school meal offered i) an opportunity for Norwegian students to improve their school functioning, concentration, social interaction and practice social skills (Illøkken et al., 2021), and ii) an arena for social learning and learning about foods and dishes among Danish students (Benn & Carlsson, 2014). However, the recent systematic review by Cohen et al. (2021) showed mixed findings on the impact of universal-free breakfast on academic performance and that studies investigating breakfast provision is limited in their short-term exposure. Longitudinal intervention studies with breakfast provision or well-designed observational studies including objective measures of academic performance should therefore be given priority in further research.

Interestingly, our results also suggested that the association between having breakfast and reading literacy among Norwegian students was weaker compared to the other Nordic countries included in this study. Further studies are needed to clarify this issue.

Methodological considerations

Due to the cross-sectional nature of this study design (Kesmodel, 2018), we cannot draw causal conclusions of the effect that having breakfast may have on reading achievement. The association between having breakfast and reading literacy might be due to several other unobserved factors that we did not adjust for. This could for instance be student social environment and parental support as argued by Lundqvist et al. (2019). Having breakfast was self-reported based on one question, which relies on perception and memory that could lead to recall bias (Stone et al., 2009). Further, we did not measure what kind of food the students had for breakfast. As Ptomey et al. (2016) indicated that both having breakfast and the content of breakfast were associated with reading performance, an investigation of the optimal breakfast habits for reading achievement may be a point for future research. However, it would be unethical to randomise students to receive a healthy vs. an unhealthy breakfast. This can be partly solved by for instance including a short dietary questionnaire for breakfast in PIRLS and by conducting long-term observational studies. A main strength of this study is that an objective measure of reading performance was used in a large sample from Denmark, Finland, Norway and Sweden among students at the same age.

Conclusion

Based on a sample of Nordic primary school students, this study showed that those who reported to have breakfast often had higher reading literacy achievement. This association was still present when adjusting for SES and gender. Promotion of breakfast and further observational studies and RCTs assessing effect of breakfast provision in school on reading literacy should therefore be given further priority in practice and research.

Notes on contributors

KEI, DR, NCØ and FNV designed the study. KEI drafted the manuscript. Statistical analyses were performed by KEI and ML. All authors were involved in interpreting the data and critically revised the manuscript. All authors approved the final version of the manuscript.

Disclosure statement

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