

Breakfast frequency among adolescents: associations with measures of family functioning

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Abstract

Objective: To investigate (i) associations between adolescents' frequency of breakfast and family functioning (close relations to parents, quality of family communication and family support) and (ii) if any observed associations between breakfast frequency and family functioning vary by sociodemographic factors.

Design: School-based cross-sectional study. Students completed a web-based questionnaire. Associations were estimated by multilevel multivariate logistic regression.

Setting: Danish arm of the Health Behaviour in School-aged Children study, 2014.

Subjects: Adolescents aged 13 and 15 years (n 3054) from a random sample of forty-one schools.

Results: Nearly one-quarter of the adolescents had low breakfast frequency. Low breakfast frequency was associated with low family functioning measured by three dimensions. The OR (95 % CI) of low breakfast frequency was 1.81 (1.40, 2.33) for adolescents who reported no close relations to parents, 2.28 (1.61, 3.22) for adolescents who reported low level of quality of family communication and 2.09 (1.39, 3.15) for adolescents who reported low level of family support. Joint effect analyses suggested that the odds of low breakfast frequency among adolescents with low family functioning compared with high family functioning were highest among adolescents being girls, immigrants and living in other than a traditional family structure.

Conclusions: Low breakfast frequency was associated with low family functioning measured by close relations to parents, quality of family communication and family support. Further, analyses suggested that the associations were more pronounced among girls, immigrants and adolescents from other family structure than traditional. The study highlights the importance of the family setting in promoting regular breakfast frequency among adolescents.

Key words
Breakfast
Adolescents
Family functioning
Sociodemographic factors

A growing literature indicates that breakfast consumption is associated with several health outcomes among adolescents. Adolescents who eat breakfast often have a more favourable nutrient intake than adolescents with low breakfast frequency^(1,2). Also, despite some inconsistency in findings⁽³⁾, an association between low breakfast frequency and overweight among children and adolescents has been observed^(2,4,5). Low breakfast frequency in childhood and adulthood is associated with metabolic risk factors in adulthood such as higher BMI, higher mean fasting insulin and higher LDL cholesterol concentrations^(6,7). Additionally, there are indications in the literature that breakfast consumption is positively associated with children's ability to concentrate in school^(2,8,9). Further, low breakfast frequency in adolescence predicts low breakfast frequency in late adolescence and young

adulthood^(10,11). In the existing literature the definition of breakfast consumption varies^(2,11–15). Whereas others have used terms such as 'breakfast pattern', 'skipping breakfast' and 'regularity of breakfast', we apply the term 'breakfast frequency'. This terminology directly reflects the applied breakfast measure in the present study.

The family is a significant setting for influencing the development of adolescents' health behaviours⁽¹⁶⁾. In the family adolescents are influenced by their parents' attitudes, beliefs and behaviours⁽¹⁶⁾. Breakfast is often consumed in the home and the family setting is therefore important when studying breakfast habits among adolescents. Others have highlighted the importance of investigating the influence of the family setting for adolescent breakfast frequency^(13,17). Breakfast frequency has been associated with the family setting characterized by

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physical factors such as food availability and food poverty in the home and sociodemographic factors such as socio-economic position⁽¹³⁾. Further, sociocultural factors have been associated with breakfast frequency and especially parental breakfast consumption and family type have been investigated in several studies⁽¹³⁾. A sociocultural factor that has had limited study is family functioning. Family functioning includes interpersonal interactions between parent and child such as problem solving, communication, roles, adaptability, warmth/closeness and behaviour control^(18,19). Low family functioning is associated with health outcomes and health behaviours such as overweight^(20,21), sedentary behaviour⁽²⁰⁾ and low intake of fruit and vegetables^(20,22,23).

Franco *et al.* suggested that adolescents who experience a high level of family communication and support are more susceptible to parents' advice about breakfast consumption⁽²⁴⁾. A recent study by Berge *et al.* found that high family functioning (communication, closeness, problem solving, behavioural control) among US adolescents (mean age of 14.4 years) was associated with daily breakfast consumption⁽²⁰⁾. Young and Fors found among US 9th–12th graders that the ability to communicate with parents about serious issues was positively associated with daily healthy breakfast (healthy not defined)⁽²⁵⁾. Also for family cohesion, involving measures of emotional bonding and supportiveness, positive associations have been found with frequent breakfast consumption among 13–16-year-old New Zealanders⁽²⁶⁾ and 9–19-year-old US adolescents⁽²⁴⁾. The existing studies have used different measures of family functioning and are based solely on populations of adolescents from the USA and New Zealand. When planning interventions it is important to get detailed insights into which aspects of family functioning are associated with breakfast frequency and whether the observed associations exist across settings.

The family setting is also characterized by socio-demographic factors and for several of these, associations with adolescent breakfast frequency have been observed. Low breakfast frequency is most common among girls and the prevalence increases with increasing age^(15,27,28). Low socio-economic position^(15,29–32), not living with two parents^(32–35) and being an immigrant^(36–38) are associated with low breakfast frequency among adolescents.

A model that can be used to gain insight into causal mechanisms between for example the family setting and energy-related behaviour is Kremers' Environmental Research framework for weight Gain prevention (EnRG) model⁽³⁹⁾. We consider breakfast frequency to be an example of weight-gaining behaviour. According to Kremers' model, the causal background for energy balance-related behaviours is the physical and socio-cultural characteristics of the settings in which people act. The model suggests that personal (e.g. sociodemographic factors) and behavioural characteristics act as modifying factors between the setting and behaviour^(39,40). Brug *et al.* highlighted that most studies have not examined the

differences in environmental correlates for distinct subgroups as proposed by the Kremers' model with regard to effect modifiers such as sociodemographic variables⁽⁴¹⁾. Information on such modifying influences is important for developing efficient public health interventions. Based on this perspective, it can be hypothesized that socio-demographic factors such as high family social class and family structure buffer the influence of low family functioning on breakfast frequency. Information on such modifying or joint influences is important for designing well-targeted public health interventions. Berge *et al.* studied the modifying effect of ethnicity on the association between family functioning and breakfast consumption, finding no modifying effect⁽²⁰⁾. Franko *et al.* studied the modifying effect of age on the association between family cohesion and frequency of breakfast consumption and found no modifying effect of age⁽²⁴⁾. Additional studies examining the modifying effect of other sociodemographic factors are still lacking.

Therefore, the aim of the current study was to gain more insight into which aspects of family functioning are associated with adolescent breakfast frequency by investigating the following research questions: (i) is there an association between family functioning (measured by close relations to parents, quality of family communication and family support) and breakfast frequency among adolescents? (ii) Are any observed associations modified by sociodemographic factors?

Methods

Study design and study population

We used Danish data from the international, cross-sectional, Health Behaviour in School-aged Children (HBSC) study⁽⁴²⁾. Data collection is conducted every fourth year in each participating country among students aged 11, 13 and 15 years (in Denmark, equivalent to 5th, 7th and 9th grade, respectively) in a random sample of schools (i.e. cluster sampling). Students completed the self-administered, internationally standardized and anonymous HBSC questionnaire at school⁽⁴³⁾. In 2014 we selected schools at random from a complete list of schools in Denmark. We used a regional-specific sampling to assure equal proportional representation of six geographical regions. We substituted every school that declined participation with another school chosen at random within the same region. In total we approached 168 schools of which forty-eight agreed to participate. In the majority of cases, the reason given for non-participation was that, at the time of recruitment, Danish schools were in the process of implementing a new and comprehensive school reform. Further, some schools had participated in similar surveys and did not have resources available for participation in yet another study. The school acceptance rate was higher among private than public

schools (χ^2 test, $P=0.0328$) but did not relate to school location or school size. We do not suspect that this non-participation pattern resulted in important student-related selection bias. The participating schools comprised 5292 students in 248 classes at grade 5, 7 and 9. Of the students present on the day of data collection, 4534 students submitted a satisfactorily completed questionnaire (based on subjective identification of questionnaires not filled in seriously). The response rate was 85.7% (4534/5292). We have no information on reasons for non-participation among students. In the Danish data collection items on family communication were mainly included in the questionnaire applied in grade 7 and 9. The sample for the present study therefore comprises 3054 students in 7th and 9th grade from 167 classes in forty-one schools. The mean age of the participants in grade 7 and 9 was 13.8 (SD 0.4) years and 15.8 (SD 0.4) years, respectively.

The study was conducted according to the guidelines laid down in the Declaration of Helsinki. In Denmark there is no formal ethics agency that grants ethical approval of school-based surveys. We received study approval from the school headmaster, the parents' school board and the students' council in each of the participating schools. Since the school headmaster and the parents' school board approved the study, we did not ask the parents for approval of the study. The students received oral and written information that participation was voluntary and anonymous. The study has been approved by the Danish Data Protection Agency (reference number 2015-621-0030).

Measurements

Dependent variable: breakfast frequency

Breakfast frequency was measured by a frequency question for weekdays. We dichotomized the variable following conceptual considerations and defined low breakfast frequency as consuming breakfast on fewer than four out of five weekdays (Table 1). The definition of low breakfast frequency varies^(2,11-15). According to the definition applied in the present study, breakfast can still be defined as frequent despite occasionally being skipped. Sensitivity analyses involving cut-off points defined by consuming breakfast on fewer than five, three, two and one weekday(s) were conducted. These showed no changes in the directions of associations. The breakfast frequency measure has been validated in a Danish study against 7 d, 24 h recall measures among 11-15-year-olds, demonstrating 87% agreement and $\kappa=0.65$ for the dichotomized variable⁽⁴⁴⁾. Also, the measure of breakfast frequency was included in a larger qualitative validation study of meal habits where face and content validity of the breakfast frequency item were tested among 11-, 13- and 15-year-old students. In total the first author conducted twenty gender-homogeneous focus group discussions at five schools with two to five students in each group.

The objective was to learn about students' perceptions and experiences of the measure immediately after they had answered the questionnaire. Further, we wished to understand how they perceived the concept of breakfast. We found high face validity as the students found it easy to answer the item. To clarify the content validity the students were asked about how they defined breakfast. The term 'breakfast' was a generally used term and the students generally defined it as food eaten in the morning before school (CA Johnson and TP Pedersen, unpublished results; available upon request).

Independent variables: family functioning

Three dimensions of family functioning were measured^(18,19): (i) closeness, measured by the extent of close relations to parents; (ii) communication, measured by the quality of family communication; and (iii) support, measured by family support.

Close relations to parents. Close relations to parents was measured by asking the students how easy they find it to talk to each of their parents/step-parents about issues that really bother them (Table 1). Following conceptual considerations responses were dichotomized for each parent: close relations to parents (= 'very easy' or 'easy') *v.* no close relations to parents (= 'difficult', 'very difficult' or 'don't have or see this person'). Afterwards the variables were combined into close relations with at least two parents, close relations with one parent, and no close relations with parents. The item has proved useful and has been reported as such by different focus groups and teams in the international HBSC study^(45,46).

Quality of family communication. Quality of family communication was measured by an index constructed based on a short version of the clear communication scale from the Family Dynamics Measure II⁽⁴⁷⁾. The students responded to four statements about the communication in their family. Based on conceptual considerations responses were dichotomized for each statement: 'strongly agree' or 'agree' (= 1) *v.* 'neither agree nor disagree', 'disagree' or 'strongly disagree' (= 0). Next the four dichotomized variables were coded into a sum score with five levels of quality of family communication: 0 (low level of quality of family communication) to 4 (high level of quality of family communication; Table 1). The short four-item version has been tested among 11-17-year-olds in the international HBSC study and showed good reliability (Cronbach's $\alpha=0.8$)⁽⁴⁵⁾. To test the reliability of the index in the present study sample we determined the index's internal consistency by Cronbach's α (= 0.9), which indicated an excellent internal consistency in the index⁽⁴⁸⁾. Further, we tested the index for differential item function (DIF) to investigate whether or not the items in the index perform differently in subgroups⁽⁴⁹⁾. We tested for DIF in relation to the included sociodemographic variables, namely gender, age group, family social class, family structure and migration status. According to Scott *et al.*, meaningful DIF

Table 1 Item wording, response keys and categorization used in analyses

Item wording	Initial categorization	Categorization used in analyses
Breakfast variable		
Breakfast consumption		
'On WEEKDAYS: How often do you usually have breakfast? (more than a glass of milk or juice)'	I never have breakfast on weekdays One day Two days Three days Four days Five days	Low breakfast frequency (never, one, two, three days) High breakfast frequency (four and five days)
Family functioning variables		
Close relations to parents		
'How easy is it for you to talk to the following persons about things that really bother you?'	Very easy Easy Difficult Very difficult Don't have or see this person	Close relations to two or more parents Close relations to one parent No close relations to parents
Quality of family communication		
'How much do you agree or disagree in the following statements about your family?'	Strongly agree (1) Agree (1)	Index for quality of family communication: High level of quality of family communication, 4 Level 3 Level 2 Level 1 Low level of quality of family communication, 0
'I think the important things are talked about'	Neither agree or disagree (0)	
'When I speak someone listens to what I say'	Disagree (0) Strongly disagree (0)	
'We ask questions when we don't understand each other'		
'When there is a misunderstanding we talk it over until it's clear'		
Family support		
'How much do you agree or disagree in the following statements about your family?'	Strongly agree (1) Agree (1)	Index for family support: High level of family support, 4 Level 3 Level 2 Level 1 Low level of family support, 0
'My family really tries to help me'	Neither agree or disagree (0)	
'I get the emotional help and support I need from my family'	Disagree (0) Strongly disagree (0)	
'I can talk about problems with my family'		
'My family is willing to help me make decisions'		
Sociodemographic variables		
Gender		
'Are you a boy or girl?'	Boy Girl	Boy Girl
Grade		
'Which grade do you attend?'	7th 9th	7th (equals 13-year-olds) 9th (equals 15-year-olds)
Family social class		
The students were asked about their parents' occupation. This information was coded by the research group and categorized into seven groups	Social class I Social class II Social class III Social class IV Social class V Economically inactive Unclassifiable	High social class (I, II, III) Low social class (IV, V + economically inactive and unclassifiable)
Migration status		
The students were asked where they and their parents were born and categorized into three groups	Natives Immigrants Descendants of immigrants	Natives Immigrants (migrants/descendants of immigrants)
Family structure		
The students were asked about who they live with and categorized into four groups	Traditional (living with two biological parents) Single parent Reconstructed (living with mother and stepfather or with father and stepmother) Others (e.g. foster homes)	Traditional Other (single parent, reconstructed, others)

should be considered if the significant odds ratio estimates are larger than 2 or lower than 0.5⁽⁵⁰⁾. We found DIF (OR = 0.42; 95 % CI 0.25, 0.70) in the group of immigrants

compared with natives for the statement: 'When there is a misunderstanding we talk it over until it's clear'. To explore the DIF with regard to migration status we

compared the final analyses with analyses conducted on a sub-sample consisting of only natives. These showed no changes in the directions of associations.

Family support. Family support was measured by an index inspired by the Multidimensional Scale of Perceived Social Support (MSPSS)⁽⁵¹⁾. The scale covers social support from both family and friends, but in the present study we included only the family component. The students responded to four statements about family support. Following conceptual considerations responses were dichotomized for each statement: 'strongly agree' or 'agree' (= 1) *v.* 'neither agree nor disagree', 'disagree' or 'strongly disagree' (= 0). Afterwards the four dichotomized variables were coded into a sum score with five levels of family support: 0 (low level of family support) to 4 (high level of family support; Table 1). The MSPSS has shown a well-established scale construction with good validity and reliability^(45,51,52). The Danish version of the index is not fully comparable with the original MSPSS as we applied five response categories ('strongly agree', 'agree', 'neither agree or disagree', 'disagree', 'strongly disagree'). The original MSPSS has seven categories from 'strongly agree' to 'strongly disagree'. We tested the family support index for internal consistency by Cronbach's α , which was high (=0.9). Further, we tested for DIF in relation to the sociodemographic subgroups and found no significant DIF.

Sociodemographic variables

We included gender, age group, socio-economic position, migration status and family structure in the analyses. Grade (7th and 9th) was used as a proxy for age group as the age variation within grades in Denmark is small. Socio-economic position was measured by family occupational social class. Students' responses to items about their parents' occupation were coded into family social class by the research staff and categorized into seven groups (social class I, II, III IV, V, economically inactive and unclassifiable). We followed the definitions of social class applied by the Danish National Institute of Social Research, which is almost identical to the UK Registrar General's classification^(53,54). In the analyses family social class was dichotomized into high (I, II, III) and low social class (IV, V, economically inactive and unclassifiable). Sensitivity analyses with group III included in the low family social class category were performed and the estimates did not change notably. Further, before including unclassifiable responses (n 244) in the low family social class group, the analyses were performed with unclassifiable categorized in a separate group. This revealed an association between the category unclassifiable and breakfast frequency similar to the association between low family social class and breakfast frequency. Students' migration status was classified as either native Danes or immigrants/descendants of immigrants, based on their responses to items about their own and their parents'

country of birth. Family structure was defined based on students' reports of who they live with and categorized as traditional family (living with two biological parents) and other (single parent, reconstructed family, other family types; Table 1).

Statistical analyses

All analyses were conducted using the statistical software package SAS version 9.3. In the descriptive analysis of distributions χ^2 tests of significance were used to examine differences in breakfast frequency by sociodemographic factors (gender, age group, family social class, family structure and migration status).

We used Cronbach's α to test the internal consistency of the quality of family communication index and the family support index. To test for DIF we used logistic regression with each item in the index as dependent variable and the index and the sociodemographic variable as independent variables^(49,50).

Logistic regression models were generated to estimate the association between breakfast frequency and (i) close relations to parents, (ii) quality of family communication and (iii) family support. Initial analyses stratified by gender revealed same-direction associations for boys and girls, and analyses are therefore presented for the total sample. To account for the risk of data dependency due to the applied cluster design, we specified three-level hierarchical models (students nested within classes nested within schools) using SAS 9.3 PROC GLIMMIX. In the first step we analysed the associations unadjusted and in the second step we adjusted the analyses for the included sociodemographic variables. In initial analyses we included the sociodemographic variables one at a time and we conducted the analyses with family social class and family structure with and without dichotomizing the variables, but the associations between family functioning and low breakfast frequency did not alter.

In the third step we tested the associations for modification by sociodemographic factors. First, we examined the overall effect modification by including interaction terms between family functioning and sociodemographic factors in the model one at a time. Second, we examined the joint effect; that is, the combined effect of two variables for the three dimensions of family functioning and the sociodemographic variables. By including the combined effect it is possible to compare associations for the different combinations of the two variables with a common reference category whereby it is possible to identify protective or harmful combinations^(55,56). Associations for all combinations were compared and those combinations that were identified as harmful were further investigated by testing for multiplicative effect modification (ratio of odds ratios = $OR_{++}/OR_{+-} \times OR_{-+} + 1$) and additive effect modification (relative excess risk due to interaction, $RERI = OR_{++} - OR_{+-} - OR_{-+} + 1$)^(57,58). The confidence intervals for the ratio of odds ratios and RERI were

calculated as proposed by Hosmer and Lemeshow⁽⁵⁹⁾. Only the relevant combinations are presented in the figures.

Only twenty-two adolescents (0.7%) did not answer the breakfast frequency item. Analyses of missing data on the family functioning measures were conducted by comparing sociodemographic differences between respondents and non-respondents and testing differences by χ^2 tests of significance. We found that adolescents with missing information on the family functioning measures were characterized by more often reporting low breakfast frequency, being a boy, being 13 years old (not significant for the measure of close relations to parents), being from low social class, being an immigrant and living in another family structure than traditional (only significant for the measure of close relations to parents; $P < 0.05$).

Results

Descriptive results

Nearly one-quarter of the adolescents consumed breakfast on fewer than four out of five weekdays (low breakfast frequency) and significantly more girls than boys reported low breakfast frequency ($P < 0.0001$; Table 2). There was a significantly larger proportion of participants with low breakfast frequency among 15- than 13-year-olds ($P = 0.0023$), adolescents from low family social class ($P < 0.0001$), immigrants ($P < 0.0001$) and other family structure than traditional families ($P < 0.0001$).

Table 2 shows that a significantly larger proportion reported low breakfast frequency among adolescents with no close relations to parents (32.8%) compared with adolescents with close relations to two or more parents (18.8%; $P < 0.0001$). A significantly larger proportion of adolescents reported low breakfast frequency when they experienced low quality of family communication (40.2%) compared with adolescents who reported high quality of family communication (18.8%; $P < 0.0001$). A significantly larger proportion of adolescents reporting low family support had low breakfast frequency (38.9%) compared with adolescents who reported high family support (19.5%; $P < 0.0001$).

Logistic regression analyses

Table 3 shows that inclusion of the sociodemographic variables in the statistical models attenuated the associations between the three measures of family functioning and breakfast frequency. Still, statistical significance remained. The adjusted analyses in Table 3 show that low breakfast frequency was associated with low family functioning when measured by three dimensions. The OR for low breakfast frequency was 1.81 (95% CI 1.40, 2.33) among adolescents who reported no close relations to parents compared with adolescents who reported close relations to two or more parents. Among adolescents who had low level of quality of family communication the OR

for low breakfast frequency was 2.28 (95% CI 1.61, 3.22) compared with adolescents with high level of quality of family communication (lower level of score compared with uppermost level of score). The OR for low breakfast frequency was 2.09 (95% CI 1.39, 3.15) among adolescents who reported low level of family support compared with adolescents who reported high level of family support (lower level of score compared with uppermost level of score).

The adjusted analyses of all three dimensions of family functioning showed associations between the included sociodemographic variables (gender, age group, family social class, migration status and family structure) and low breakfast frequency. Low breakfast frequency was more common among girls, 15-year-olds, adolescents from low family social class, immigrant adolescents and adolescents living in other family structures than traditional.

Effect modification analyses

The joint effect analysis suggested for all three dimensions of family functioning that the odds of having low breakfast frequency among adolescents with low compared with high family functioning were considerably higher among girls than among boys (Figs 1–3). This finding was supported by tests for effect modification. We found positive additive effect modification of no close relations to parents and being a girl, RERI = 1.30 (95% CI 0.19, 2.42). Further, we found positive multiplicative and additive effect modification of low level of quality of family communication and being a girl. The multiplicative ratio of odds ratios = 2.32 (95% CI 1.09, 4.96), RERI = 2.89 (95% CI 0.84, 4.95). We found positive effect modification of low level of family support and being a girl but the finding was not significant.

Further, the joint effect analyses suggested that the odds of having low breakfast frequency for adolescents with no close relations to parents compared with adolescents with close relations to two or more parents were considerably higher among immigrants than among native Danes, OR = 5.96 (95% CI 3.20, 11.09; figure not shown). Test for effect modification showed positive effect modification but the finding was not significant. Further, the odds of having low breakfast frequency for adolescents with low level of family support compared with adolescents with high level of family support were considerably higher among immigrants than among native Danes, OR = 5.56 (95% CI 1.85, 16.73; figure not shown). Further, test for effect modification revealed positive effect modification but the finding was not significant. Also the odds of having low breakfast frequency for adolescents with low compared with high family support were considerably higher among adolescents living in a family structure other than traditional as compared with adolescents from a traditional family structure, OR = 4.35 (95% CI 2.48, 7.62; figure not shown). Test for effect modification showed positive effect modification but the finding was not significant. The joint

Table 2 Gender-specific distribution of family functioning variables, sociodemographic variables and the proportion of low breakfast frequency among adolescents (*n* 3054) aged 13 and 15 years, Danish arm of the Health Behaviour in School-aged Children study, 2014

	Girls (<i>n</i> 1570)			Boys (<i>n</i> 1484)			Total (<i>n</i> 3054)		
	Low breakfast frequency*			Low breakfast frequency*			Low breakfast frequency*		
	<i>n</i>	<i>n</i>	%	<i>n</i>	<i>n</i>	%	<i>n</i>	<i>n</i>	%
Family functioning									
Close relations to parents									
Close relations to at least two parents	851	191	22.4	997	156	15.7	1848	347	18.8
Close relations to one parent	434	139	32.0	230	51	22.2	664	190	28.6
No close relations to parents	251	98	39.0	203	51	25.1	454	149	32.8
Missing	34	10	29.4	54	17	31.5	88	27	30.7
Quality of family communication									
High level of quality of family communication, 4	826	184	22.3	872	135	15.5	1698	319	18.8
Level 3	271	81	29.9	258	50	19.4	529	131	24.8
Level 2	191	59	30.9	113	27	23.9	304	86	28.3
Level 1	115	38	33.0	102	25	24.5	217	63	29.0
Low level of quality of family communication, 0	125	61	48.8	74	19	25.7	199	80	40.2
Missing	42	15	35.7	65	19	29.2	107	34	31.8
Family support									
High level of family support, 4	935	214	22.9	977	159	16.3	1912	373	19.5
Level 3	249	69	27.7	189	30	15.9	438	99	22.6
Level 2	135	52	38.5	93	24	25.8	228	76	33.3
Level 1	103	37	35.9	58	15	25.9	161	52	32.3
Low level of family support, 0	78	37	47.4	61	17	27.9	139	54	38.9
Missing	70	29	41.4	106	30	28.3	176	59	33.5
Sociodemographic variables									
Age group									
13-year-olds	804	207	25.8	771	124	16.1	1575	331	21.0
15-year-olds	766	231	30.2	713	151	21.2	1479	382	25.8
Family social class									
High	879	195	22.2	848	126	14.9	1727	321	18.6
Low	668	234	35.0	591	134	22.7	1259	368	29.2
Missing	23	9	39.1	45	15	33.3	68	24	35.3
Migration status									
Natives	1317	324	24.6	1253	202	16.1	2570	526	20.5
Immigrants	163	82	50.3	157	51	32.5	320	133	41.6
Missing	90	32	35.6	74	22	29.7	164	54	32.9
Family structure									
Traditional	1098	261	23.8	1051	169	16.1	2149	430	20.0
Other	436	165	37.8	373	86	23.1	809	251	31.0
Missing	36	12	33.3	60	20	33.3	96	32	33.3

*Low breakfast frequency defined as eating breakfast on less than four days during weekdays.

effect analyses with age group and family social class did not reveal any modifying effect.

Discussion

The present study showed that nearly one-quarter of Danish adolescents had low breakfast frequency and that low breakfast frequency was most common among 15-year-olds, adolescents from low family social class, immigrant adolescents and adolescents from other family structures than traditional families. Low breakfast frequency was associated with low family functioning measured by three dimensions: close relations to parents, quality of family communication and family support. Joint effect analyses suggested that the relationship between low family functioning and low breakfast frequency was stronger among girls than among boys. These findings were supported by effect modification tests for the two

family functioning dimensions of close relations to parents and quality of family communication.

The finding that low family functioning is associated with low breakfast frequency corresponds to previous studies of family functioning and breakfast consumption among adolescents, although the measures for family functioning vary by study^(20,25,26,60). Berge *et al.* studied daily breakfast consumption and family functioning by measuring family communication, closeness, problem solving and behavioural control⁽²⁰⁾. Franko *et al.* studied breakfast frequency and family cohesion measured by emotional bonding, supportiveness, family boundaries and spending time together⁽²⁴⁾. Moore and Harre studied breakfast frequency and family cohesion measured by emotional bonding, space, friends and decision making⁽²⁶⁾ and Young and Fors studied daily consumption of healthy breakfast and communication with parents about serious issues⁽²⁵⁾. The latter is similar to our measure of close relations to parents. Young and Fors found results similar

Table 3 Odds ratios (95% CI) for low breakfast frequency by family functioning, unadjusted and adjusted for sociodemographic variables, among adolescents (*n* 3054) aged 13 and 15 years, Danish arm of the Health Behaviour in School-aged Children study, 2014

	Crude		Adjusted	
	OR	95% CI	OR	95% CI
Close relations to parents		(<i>n</i> 2955)		(<i>n</i> 2751)
Close relations to one parent <i>v.</i> two	1.69	1.37, 2.08	1.37	1.09, 1.72
Close relations to none parents <i>v.</i> two	2.08	1.64, 2.62	1.81	1.40, 2.33
Gender				
Girls <i>v.</i> boys			1.77	1.46, 2.16
Age group				
15-year-olds <i>v.</i> 13-year-olds			1.32	1.09, 1.61
Family social class				
Low <i>v.</i> high			1.43	1.18, 1.74
Family structure				
Other <i>v.</i> traditional			1.60	1.30, 1.96
Migration status				
Immigrants <i>v.</i> natives			2.64	1.98, 3.52
Quality of family communication		(<i>n</i> 2937)		(<i>n</i> 2739)
Level 3 <i>v.</i> High level of quality of family communication, 4	1.44	1.13, 1.82	1.40	1.09, 1.80
Level 2 <i>v.</i> High level of quality of family communication, 4	1.75	1.31, 2.32	1.58	1.17, 2.13
Level 1 <i>v.</i> High level of quality of family communication, 4	1.78	1.28, 2.46	1.61	1.14, 2.29
Low level of quality of family communication, 0 <i>v.</i> High level of quality of family communication, 4	2.92	2.12, 4.01	2.28	1.61, 3.22
Gender				
Girls <i>v.</i> boys			1.76	1.45, 2.13
Age group				
15-year-olds <i>v.</i> 13-year-olds			1.35	1.11, 1.64
Family social class				
Low <i>v.</i> high			1.42	1.16, 1.72
Family structure				
Other <i>v.</i> traditional			1.52	1.24, 1.87
Migration status				
Immigrants <i>v.</i> natives			2.77	2.08, 3.70
Family support		(<i>n</i> 2869)		(<i>n</i> 2678)
Level 3 <i>v.</i> High level of family support, 4	1.18	0.91, 1.52	1.13	0.86, 1.48
Level 2 <i>v.</i> High level of family support, 4	2.12	1.56, 2.87	1.90	1.37, 2.63
Level 1 <i>v.</i> High level of family support, 4	2.02	1.41, 2.89	1.58	1.06, 2.35
Low level of family support, 0 <i>v.</i> High level of family support, 4	2.63	1.81, 3.80	2.09	1.39, 3.15
Gender				
Girls <i>v.</i> boys			1.76	1.45, 2.15
Age group				
15-year-olds <i>v.</i> 13-year-olds			1.39	1.14, 1.70
Family social class				
Low <i>v.</i> high			1.39	1.14, 1.70
Family structure				
Other <i>v.</i> traditional			1.58	1.28, 1.94
Migration status				
Immigrants <i>v.</i> natives			2.80	2.09, 3.75

Significant associations are shown in bold font.

to ours although studying healthy breakfast (not defined). The findings for the three dimensions of family functioning included in the present study add to the existing findings and highlight the importance of family functioning in relation to breakfast consumption.

With the exception of quality of family communication, the joint effect analyses of the present study suggested that the combination of being an immigrant and having low level of family functioning increased the risk of low breakfast frequency. One previous study investigated the modifying effect of ethnicity, but did not identify such⁽²⁰⁾. The present findings therefore add to the literature documenting less frequent breakfast consumption among

immigrants compared with natives^(36–38). Our findings also suggested that the combined effect of being a girl and having low family functioning increased the odds for low breakfast frequency. It is well documented that girls skip breakfast more often than boys^(15,27,28). The present findings add to this knowledge and highlight the relevance of gender when aiming at understanding the relationship between family functioning and breakfast habits. Further, analyses also suggested that living in another family structure than traditional and having low family support increased the odds of low breakfast frequency. Interestingly, this finding is present for only one of the dimensions of family functioning (family support). Still, it adds to the

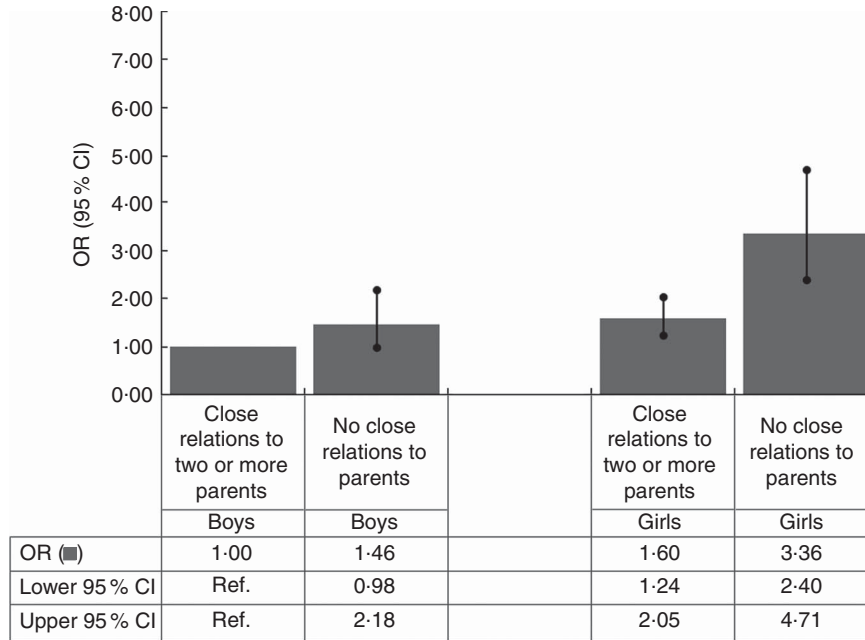


Fig. 1 Odds ratios (with 95 % CI represented by vertical bars) for low breakfast frequency by combinations of close relations to parents and gender, adjusted for sociodemographic variables*, among adolescents (*n* 3054) aged 13 and 15 years, Danish arm of the Health Behaviour in School-aged Children study, 2014. Effect modification of the combination of no close relations to parents and being a girl: ratio of odds ratios = $3.36 / (1.46 \times 1.60) = 1.44$ (95% CI 0.86, 2.42); relative excess risk due to interaction = $3.36 - 1.46 - 1.60 + 1 = 1.30$ (95% CI 0.19, 2.42). *Only the combinations that had an effect are illustrated (ref., reference category)

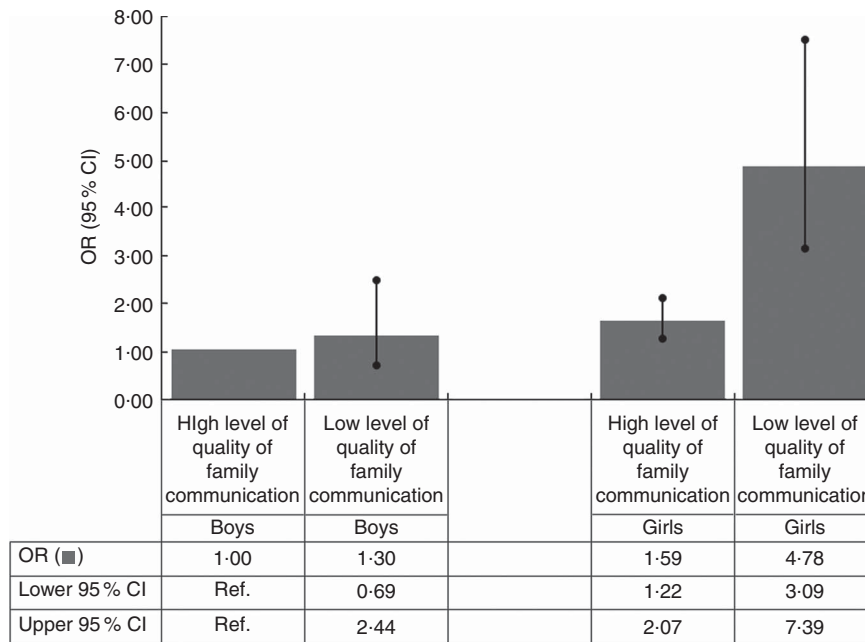


Fig. 2 Odds ratios (with 95 % CI represented by vertical bars) for low breakfast frequency by combinations of quality of family communication and gender, adjusted for sociodemographic variables*, among adolescents (*n* 3054) aged 13 and 15 years, Danish arm of the Health Behaviour in School-aged Children study, 2014. Effect modification of the combination of low level of family communication and being a girl: ratio of odds ratios = $4.78 / (1.30 \times 1.59) = 2.32$ (95% CI 1.09, 4.96); relative excess risk due to interaction = $4.78 - 1.30 - 1.59 + 1 = 2.89$ (95% CI 0.84, 4.95). *Only the combinations that had an effect are illustrated (ref., reference category)

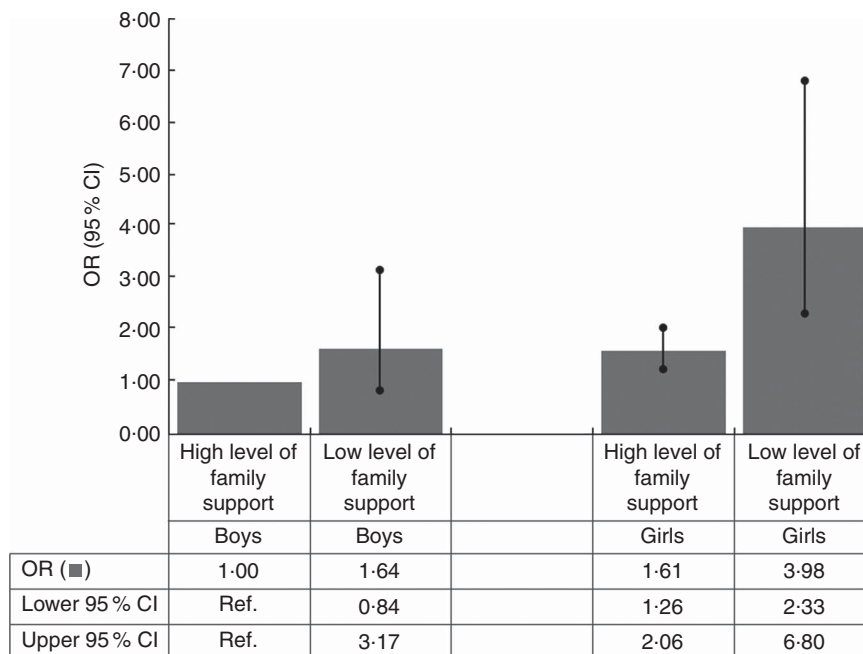


Fig. 3 Odds ratios (with 95 % CI represented by vertical bars) for low breakfast frequency by combinations of family support and gender, adjusted for sociodemographic variables*, among adolescents (n 3054) aged 13 and 15 years, Danish arm of the Health Behaviour in School-aged Children study, 2014. Effect modification of the combination of low level of family support and being a girl: ratio of odds ratios = 3.98/(1.64 × 1.61) = 1.51 (95 % CI 0.65, 3.52); relative excess risk due to interaction = 3.98 – 1.64 – 1.61 + 1 = 1.73 (95 % CI –0.54, 4.00). *Only the combinations that had an effect are illustrated (ref., reference category)

existing knowledge of family structure and adolescents' breakfast consumption^(32–35).

Kremers' model highlights the importance of the family setting for adolescent energy-related behaviours^(39,40). Breakfast consumption has earlier been shown to be associated with the family setting⁽¹³⁾ and the measures of family functioning included in the present study support the importance of the family setting when studying breakfast consumption among adolescents. It could be hypothesized that adolescents who experience a high level of family communication and support are more susceptible to parents' advice about breakfast consumption and healthy living⁽²⁴⁾. High family functioning could also be a general characteristic of families that support healthy habits and provide the availability of breakfast or even share the breakfast meal⁽²⁴⁾.

Limitations and strengths

The presented results should be assessed in relation to considering the limitations and strengths of the study. The response rate in the participating schools was high but the risk of selection bias cannot be neglected. If non-respondents are more likely to come from low family functioning families and also more likely to skip breakfast, the presented associations between family functioning and breakfast frequency may be underestimated.

Further, analyses of adolescents not responding to the family functioning items revealed that the group of non-respondents more often had low breakfast frequency,

were a boy, were 13 years old, came from low social class, were an immigrant or from other family structure than traditional. The proportion of missing was small (close relations to parents, 2.9%; quality of family communication, 3.5%; family support, 5.8%).

The current study was conducted based on a cross-sectional study design and it is therefore not possible to establish a causal link. In the study family functioning is considered to be a determinant for breakfast frequency. However, it could be hypothesized that a shared meal may lead to better family functioning. Others have found an association between family functioning and shared family meals⁽²⁰⁾ and the family meal has been used as a measure of family functioning⁽⁶¹⁾.

The applied family functioning measures are widely used and the internal reliability has been tested in the present study sample. The measure of close relations to parents is limited to only including parents and step-parents. Family constellations differ and adolescents could have close relations to other than parents.

In the present study parents' working hours could constitute unmeasured confounding. Parents who leave for work early or sleep late due to late working hours do not have the possibility for providing breakfast for their children⁽⁶²⁾. Also, it could be hypothesized that the absence of parents due to working hours may affect adolescents' perception of their family's functioning. Unfortunately, the study does not include data about parents' working hours.

The present study is strengthened by inclusion of a large, nationally representative sample of adolescents. The response rates were high and initial pilot studies suggested that the measurement of breakfast frequency was valid. Further, for the included sociodemographic variables we tested effect modification by both multiplicative and additive effect modification. The multiplicative effect modification is often reported in epidemiological studies but the importance of presenting effect modification on both the multiplicative and additive scales has been emphasized, and the additive effect modification has been stated as more relevant in public health research^(55,56). In the current study some of the joint effect findings are not supported by the effect modification tests, which may be due to a limited sample size. Investigating effect modification is most appropriate in large data samples as such estimations are very power-sensitive⁽⁵⁸⁾. Rothman and Greenland recommend that assessments are not based on statistical significance alone⁽⁶³⁾.

Implications

Breakfast consumption has been highlighted as important for the health of adolescents and the present study emphasizes the importance of including the family setting, particularly family functioning, in future studies of adolescent breakfast consumption. To understand the mechanisms underlying the link between family functioning and breakfast consumption, additional qualitative and quantitative studies should be conducted. Qualitative studies would contribute to a deeper and more detailed understanding of the underlying mechanism. Quantitative studies should include combinations of family functioning measures and other measures of family functioning such as measures of family meal culture, and also explore the importance of parents' working hours. Others have found positive associations between parental monitoring⁽²⁵⁾, parental style⁽⁶⁴⁾ and breakfast frequency and this supports the importance of the family setting. Further, also the social context of the breakfast meal, such as the shared family breakfast meal, has been associated with better nutrition⁽⁶⁵⁾ and others have found an association between family functioning and shared family meals⁽²⁰⁾. To understand these underlying mechanisms additional research is needed. Further, future studies should also refine the breakfast measure to include measures of quality of the breakfast meal and measures of where the breakfast meal is consumed.

The practical implications of the present study relate to the emphasis that should be directed towards the family setting when intervening at breakfast consumption. However, intervening directly at family functioning is difficult. Instead adolescents who skip breakfast may be reached through providing breakfast at school. This is in line with the ecological theory, which suggests that the effect of one setting (e.g. school) on health behaviour may modify the effect of another setting (e.g. family)⁽⁶⁶⁾.

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