Frequency of family meals and childhood overweight: a systematic review

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Summary

Energy balance is influenced by understudied genetic, social and other environmental factors. The frequency of family meals (FFM) may be one of these factors since it is associated with a healthier dietary pattern in children and adolescents. The objective of this review is to evaluate the scientific evidence on the association between FFM and the risk of childhood and adolescent overweight. The electronic literature search identified 394 articles published during 2005–2012. Of these, 15 studies gave precise information of the studied association, of which four were longitudinal. We found great variability regarding the measurement of FFM. Six out of 11 cross-sectional studies and 1 out of 4 longitudinal studies found statistically significant inverse associations between FFM and being overweight, mainly in children, with odds ratios ranging from 0.11 to 0.93. Of those, only one adjusted for all the potential confounding factors considering socio-demographic, physical activity- and diet-related variables. Therefore, this review found inconsistent and weak evidence of an inverse association between FFM and risk of childhood overweight. In conclusion, further research is needed to establish whether family meals have an effect on childhood overweight. These studies ideally should have longitudinal or experimental designs, a clear and standardized definition of the exposure under study, a measure of the exposure based on direct observation or validated questionnaires and an adequate adjustment for potential confounders.

Keywords: family meals, childhood overweight.

Abbreviations: BMI, body mass index; CDC, Centers for Disease Control and Prevention; FFM, frequency of family meals; SEP, socioeconomic position.

Introduction

The childhood obesity pandemic is a serious public health problem (1,2). The proximate obesity cause is an imbalance between energy intake and expenditure. However, the energy balance is influenced by understudied genetic, social and other environmental factors (3), which complicates the design of effective prevention interventions (4).

Frequent family meals may improve the energy balance since family meals are associated with a healthier and more varied dietary and nutritional pattern (5). This effect is bound to be especially significant for younger children when parents exert greater influence on the development of eating habits (6). Further, adolescents who eat with their families more often report higher psychosocial well-being as well as lower risk of addictive risk behaviours (7,8) and disordered eating behaviours (9).

The increase in prevalence of childhood obesity during the last decades of the 20th century has paralleled the decrease in frequency of family meals (FFM) (10). However, although the first study that observed an inverse relationship between the body mass index (BMI) in children and FFM dates back to 2000 (5), an analysis of the potential influence of FFM on obesity adjusting for potential confounding factors was not performed until 2005 (11–13). If the protective effect of FFM on weight is confirmed, promoting family meals could be an effective strategy to
prevent childhood overweight. Further, as a general health promotion measure bound to enhance children's intellectual, social and emotional development, it should enjoy wide parental support.

A recent meta-analysis found that having family meals three or more times per week was associated with a 12% reduction in children and adolescent overweight risk (14). However, the analysis did not account for certain characteristics of the studies examined, such as study design (cross-sectional vs. longitudinal), whether height and weight were measured or self-reported, the degree to which potential confounders were controlled for, or possible effect modifications by sex, age or race/ethnicity. Finally, since its publication in 2011, new evidence has emerged that deserves consideration (15–17).

This work is a systematic review of the literature that evaluates the existing scientific evidence on the relationship between FFM and the risk of overweight among children and adolescents.

**Materials and methods**

To ensure transparency and complete reporting, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement recommendations have been followed where applicable (18), including a checklist (presented as supplemental information in Supporting Information Table S1) and a flow chart (Fig. 1) describing the study selection process.

**Literature search and selection**

In July 2011, five search engines were used to systematically locate articles published since 2005: PubMed, Scopus, PsycINFO, Global Health and IBECS (Spanish Bibliographic Index for the Health Sciences). The following keywords were chosen as search terms: ('obesity' or 'overweight' or 'weight gain') and ('family meals' or 'frequency of family meals' or 'family dinner' or 'frequency of family dinner'). During a second phase, two MeSH search terms were used in the search: 'feeding behavior' and 'parents child relations'. We repeated the systematic search on January 2012. Reference lists of the articles identified were also reviewed for potential papers. The complete search strategy is presented as supplemental information in Supporting Information Table S2.
This review included original articles addressing children and adolescents (<18 years of age), which met the following criteria: (i) must be peer reviewed; (ii) written in English or Spanish; (iii) reporting findings from original research examining the relationship between FFM and any of the following variables: BMI, overweight prevalence, waist circumference, abdominal obesity or any other measures of adiposity. We excluded studies with no information on the variables of interest as well as those that failed to analyze or present quantitative estimates of the study associations. We also excluded one study that reported significant associations only in aggregate form for a wide age band (10–29-year-olds). When same data were examined in more than one article, we selected the one that analyzed the relationship between FFM and overweight most directly.

Two researchers (J.V. and L.A.) selected and extracted the data independently; discrepancies were resolved by consensus or through case conference with a third researcher (M.A.R.).

Quality evaluation of the studies

The quality of the studies was evaluated based on sample representativeness and methodological design, measurement of the study variables and the degree of adjustment for potentially confounding factors.

Response rate and retention rate were evaluated in cross-sectional and longitudinal studies, respectively. In the studies under examination, we evaluated whether the information on FFM was collected from the participants through a self-administered questionnaire, or an interview (face-to-face or via telephone), or in their absence, whether data were collected from parents or guardians. We also examined whether the questionnaire included additional information explaining how a family meal was defined (number of diners, the location (home, away from home), whether the television is on during the meal). The source of the data for the outcome variables, i.e. whether weight, height and waist circumference were objectively measured or self-reported, was also considered. When overweight and obesity were defined based on BMI, the method to define the cut points was also described. Finally, to evaluate degree of adjustment, we considered four groups of control variables: (i) age and gender; (ii) socioeconomic position (SEP); (iii) physical activity and/or sedentary lifestyle; and (iv) diet.

Data analyses

The application of meta-analytical techniques was considered inappropriate due to the great methodological variability found among studies in terms of design, study population, definition and classification of variables of interest, measures of association and results. We present the studies’ information separately according to the study design. Longitudinal studies with satisfactory level of adjustment for confounding factors were assigned more weight in our discussion and conclusions sections.

Results

Figure 1 shows the flow chart of the study selection process. The electronic database search identified 394 articles. After discarding any duplicates, there were 302 left, of which 261 were excluded based on title and abstract because they did not address the association under study. Of the articles remaining, 26 were excluded after reading the full text. From these 26 articles, 12 did not contain data on the study variables, 7 did not report on the association among study variables, 3 were reviews, 2 did not report quantitative results, 1 did not disaggregate results for those under 18 years of age and 1 was an editorial. Consequently, this review included 15 articles.

Tables 1 and 2 describe the original studies’ methods and main findings. Most studies \( n = 11 \) were cross-sectional \( (11,13,15–17,19–24) \) versus four longitudinal studies \( (12,25–27) \). Nine studies took place in the United States, three in Canada and the other three in New Zealand, Korea and Japan. Sample sizes ranged between 139 and 16,770 participants, for a total of 74,080 participants aged 4 to 18 years. Six of the studies included only participants under the age of 12 (children) \( (13,17,19,21,23,26) \), seven studies included only those over 12 years of age (adolescents) \( (11,15,16,20,22,25,27) \) and the last two studies included both children and adolescents \( (12,24) \). They all included subjects from both genders except one study of girls only (16). Two-thirds of the studies used school-based samples \( \left( n = 10 \right) \) \( (13,15–17,20,22–26) \), whereas the rest \( \left( n = 5 \right) \) used national surveys of children and adolescents \( (11,12,19,21,27) \).

Table 3 shows aggregate results of the quality evaluation analysis. Studies were methodologically heterogeneous. All of them calculated BMI; however, 40% \( \left( n = 6 \right) \) used self-reported weight and height data. Bauer et al. also calculated percent body fat using dual-energy X-ray absorptiometry (16). The only study to describe the relationship between FFM and waist circumference was excluded because it
Table 1 Characteristics and main results of the cross-sectional studies included

| Authors/year/country | Sample characteristics | Age mean or range | Response rate | Anthropometric measurement | Frequency of family meals (FFM) measurement | Control variables | Risk of overweight | Main limitations |
|----------------------|-----------------------|------------------|---------------|-----------------------------|------------------------------------------|------------------|------------------|------------------|
| Vougelers and Fitzgerald 2005 (13) Canada | 4298 children (49% males) from 282 Schools of Nova Scotia | 10–11 | 51.1% | Measured weight and height, Overweight based on BMI international standards criteria for age and sex (Cole et al., 2000). | Self-reported by Harvard’s Youth/Adolescent Food Frequency Questionnaire, Frequency of family supper: once a week, 1–2, 3–4 and ≥5 times a week | Gender, lunch habits, participation in physical activities, parental education, neighbourhood income, frequency of physical education classes | Reporting eating supper with family ≥ 3 times a week vs. reporting less than once a week. OR 0.68 (95% CI 0.52–0.88) | Low response rate |
| Mamun et al. 2005 (11) Australia | 2325 adolescents (52% males) from a longitudinal study of women and their offspring in Brisbane: 91% white, 5% aboriginal islander, and 4% Asian | 14 | 53% (61% of them have complete data on all control variables) | Measured weight and height, Overweight based on BMI international standards criteria for age and sex (Cole et al., 2000) | Mothers reported by questionnaire, How often does your family eat together? At least once a day, a few times a week and about once or less than once a week | Race, age, gender, being overweight at 5-year of age, maternal parity, gross family income, maternal education, maternal attitude towards child’s consumption of fatty foods, frequency of fast food/soft drinks and red meat, hours of TV watching per day and days spent on sports per week. | Reporting family meals at least once a day vs. a few times/once/less than once a week OR: 1.05 (NS*) | Mothers reported FFM. Adolescents who did not participate were from lower SEP, and mothers were more likely to have had low education and to be non-white. |
| Utter et al. 2008 (22) New Zealand | 3245 adolescents (48% males) from six schools of the Pacific Obesity Prevention in Communities study (POCP): 63% Pacific Island, 19% Maori, 11% Asian/other, 8% European | 14.8 | 62% (96% of them had complete survey data about nutrition and physical measurements) | Measured weight and height | Self-reported by questionnaire, In the last five school days, how many times did all or most of your family living in your house ate an evening meal together? none, 1-2, 3-4 and everyday | Gender and age | NS* inverse association between FFM and BMI | Non-representative sample of adolescents from an economically disadvantaged area. Not controlled by SEP, diet and physical activity-related variables |
| Yuasa et al. 2008 (23) Japan | 3291 (50% males) school children from first and fourth grade of elementary school and first grade of junior high school from 127 randomly selected schools from Tokushima Prefecture | 6/9/12 (according to school grades) | 99% | Self- and parent-reported weight and height, Obesity defined as ≥120% of the Tokushima standard weight for sex and height data (2000) | Parents reported for elementary school children, and self-reported for junior high children by questionnaire, Do you eat together as a family, at least once a day? almost every day (6–7) and not every day (0–5 times a week) | School grade | NS* inverse association between FFM and prevalence of obesity. | Self-report or parents reported anthropometric data. Not controlled by SEP, diet and physical activity related variables (which were collected) |
| Study | Participants | Region | Age | Gender | Methodology | Anthropometric Data | Overweight Definition | Reporting Dinner Frequency | Results |
|-------|--------------|--------|-----|--------|-------------|---------------------|----------------------|--------------------------|---------|
| Woodruff and Hanning 2009 (24) | 3223 students (48% males) from sixth, seventh and eighth grade from 86 schools in Northern Ontario, Southern Ontario and Nova Scotia | Canada | 10–14 | 51.2% (according to school grades) | Self-reported weight and height | Self-reported by a web-based Food Behaviour Questionnaire | Typically, How many days per week do you eat dinner or supper with at least one parent? 0–7 d a week. | Gender, school grade, fast food frequency, pop drinks consumption, having breakfast, dieting, concern of high weight, self-efficacy for healthy eating: at home, at school with friends, during social events and when alone. | OR 1.00 for overweight and OR 1.08 (NS*) for obesity, for each additional dinner or supper eaten in family |
| Fulkerson et al. 2009 (20) | 139 adolescents (51% males) from four alternative high schools in Minnesota: 40% white, 31% black/African–American, and 23% Hispanic/other | USA | 17.2 | 36% (96% of them have complete data on all control variables) | Measured weight and height | Overweight: BMI ≥ 85th percentile based on CDC standards for age and sex | Self-reported by questionnaire. During the past week, how many days did all or most people you live with, dinner together? Never, 1–4 times a week or 5–7 times a week | Race, gender, random effect of school, and socioeconomic position | Reporting dinner in family 5–7 times a week vs. never OR 0.36 (CI 95% 0.14–0.91) |
| Rollins et al. 2010 (21) | 16770 children (52% males) from the National Child Health Survey 2003: 79% non-Hispanic white, 11% non-Hispanic black and 10% Hispanic | USA | 6–11 | 90% | Weight and height reported by parents | Overweight: BMI ≥ 85th percentile based on CDC standards for age and sex | Mothers reported by telephone interview During the past week, how many days did all the family members who lived in the household eat a meal together? : 0–2, 3–4, 5–6 d a week and everyday | Gender, age, poverty level, household educational level, family structure (two/single parent) | Having a meal with all the family 5–6 d a week vs. 0–2 d a week OR 0.67 (95% CI 0.52–0.87) only for obesity in non-Hispanic whites |
| Anderson and Whitaker 2010 (19) | 8550 pre-school children (51% males) from a national representative sample: 54% non-Hispanic white, 15% non-Hispanic black, 24% Hispanic, 6% Other | USA | 4 | 97% | Measured weight and height | Overweight based on BMI international standards criteria for age and sex (Cole et al., 2000) | Mothers reported by interview In a typical week, how many days at least some of the family eat the evening meal together? 1–7 d a week | Race, gender, age, household income poverty ratio, single-parent household, maternal education/BMI/age, obtaining ≥ 10.5 h sleep per weeknight, limiting screen-viewing time (TV, videos, DVD) to ≤ 2 h per weekday | Having the routine of eating 6–7 times per week vs. lack of routine. OR 0.77 (95% CI 0.65–0.92) for obesity |

Self-reported anthropometric data. Low response rate Not controlled by SEP and physical activity-related variables

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| Authors/year/country | Sample characteristics | Age mean or range | Response rate | Anthropometric measurement | Frequency of family meals (FFM) measurement | Control variables | Risk of overweight | Main limitations |
|----------------------|------------------------|------------------|--------------|----------------------------|---------------------------------------------|------------------|-------------------|------------------|
| Goldfield et al., 2011 (15) Canada | 1764 (41% males) adolescents from middle and high schools from Ottawa: 50% North-American, 25% European, 9% Asian, 14% other. | 14.1 | 99% | Measured weight and height | Self-reported by Attitudes and Patterns of Eating (APE) questionnaire | Gender, age, parental education, frequency of snack-food. | FFM was inversely associated with BMI only in females $b^† = -0.320; P = 0.001$ | Not representative sample of adolescents from highly educated families |
| Lee et al., 2011 (17) Korea | 261 children (52% males) from second and third grades of an elementary school in Seoul | 7-9 | 87% | Measured weight and height | Obesity: BMI $> 95$th and Overweight $> 85$th percentile based on the Korean Children and Adolescents Growth Standards (2007) | Parents or guardians reported by questionnaire frequency of family meals (lack of detailed information about the specific question asked): 1/day, 4-6/week, 1-3/week and 2-3/month | Gender, age, mother’s education, mother’s BMI, parental diabetes | Reporting eating with their family 1 meal per day versus less than 3 meals per month. OR 0.11 (95% CI 0.01-0.83) | Parents reported FFM Small and not representative sample Not controlled by diet and physical activity-related variables |
| Bauer et al., 2011 (16) USA | 253 girls (and their parents) from 12 schools who participated in New Moves, a physical and nutrition intervention in Minnesota: 29% white, 26% African-American/black, 24% Asian, 11% Hispanic, 3% American Indian, 8% mixed race/other | 15.7 | 71% | Measured weight and height | Overweight: BMI $> 85$th percentile based on CDC standards for age and sex. Total percentage of body fat assessed by dual-energy X-ray absorptiometry | Parents reported by questionnaire Weekly frequency of family meals (lack of detailed information about the specific question asked) | Race, age, parental education, random effect of school and physical activity, television and dietary intake family environment ‡ | NS* inverse association between FFM and BMI or percentage of body fat | Parents reported FFM Small sample |

*NS, non-statistically significant ($P > 0.05$).
†$b$, beta coefficient from multiple regression analysis.
‡Physical Activity Family Environment: home PA resources, parental total PA, parental moderate-to-vigorous PA, family support to PA; TV Family Environment: media resources, numbers of TVs in home, TV in bedroom, parental TV use, familial encouragement to decrease TV use; Dietary Intake Family Environment: home availability of fruits and vegetables/healthy food and soft drink, parental fruits and vegetables intake, familial encouragement to eat healthy food, fast food family meal frequency. SEP, socioeconomic position.
Table 2  Characteristics and main results of longitudinal studies included

| Authors/year/country          | Sample                           | Age (mean or range) | Follow-up duration/retention rate | Anthropometric measurement | Frequency of family meals (FFM) measurement | Control variables                                                                 | Risk of overweight        | Main limitations                                                                 |
|------------------------------|----------------------------------|---------------------|----------------------------------|----------------------------|---------------------------------------------|-------------------------------------------------------------------------------------|----------------------------|-----------------------------------------------------------------------------------|
| Taveras et al. 2005 (12) USA | 14431 school children (46.1% males) from national cohort of registered nurses: 93% non-Hispanic white | 9–14                | 3 years (1996–1999)              | 87.5 %                       | Self-reported weight and height              | Race, gender, age, baseline and follow-up menstrual status and Tanner stage, baseline height, annual change in height, BMI z-score, physical activity and inactivity | Longitudinal analysis (1 year incidence) Dinner with family every day vs. never or some days OR 0.85 (CI 0.76–0.96) | Self-reported anthropometric data Non representative sample (sons and daughters of registered nurses mainly from one racial group) Not controlled by SEP and diet-related variables |
| Sen 2006 (27) USA            | 5014 (3774 in the longitudinal analysis) pre- and adolescents from a national cohort: 55% non-Hispanic whites and 45% Hispanics and black | 12–15               | 3 years (1997–2000)              | 70.9 %                       | Self-reported weight and height              | Race, gender, age, attainment of puberty, family structure, maternal education, poverty status, computer in the household and family connectedness | Longitudinal analysis (3-year incidence) Null or NS* associations in most subgroups analyzed (stratified by race and sex) Cross-sectional analysis Dinner with family every day vs. never or some days OR 0.55 (CI 0.32–0.94) | Self-reported anthropometric data Not controlled by diet and physical activity-related variables |
| Gable et al. 2007 (26) USA   | 8000 school children (48% males) from a national cohort: 63% non-Hispanic white, 16% Hispanic, 10% African-American, 5% Asian, 3% multirace, 2% native Hawaiian/Pacific islander, and 1% American Indian or Alaskan native | 5.7 (mean age at baseline) | 3 years (1998–2001)              | 49 %                         | Measured weight and height                  | Race, gender, age, socioeconomic position, child TV hours per week, child aerobic exercise days per week, child opportunities for activity, and neighbourhood safety | Longitudinal analysis (3-year incidence) For each breakfast or dinner eaten together as a family OR 0.93 (95%CI 0.90–0.97) | Parents reported FFM Low retention rate Not controlled by diet-related variables |
| Fulkerson et al. 2008 (25) USA | 2516 adolescents (45% males) from Minnesota: 48% white, 19% Asian, 18% African-American, 6% Latino, 4% native American and 4% other/mixed | 15 (mean age at baseline) | 5 years (1998–2003)              | 53 %                         | Self-reported weight and height              | Race, age, baseline overweight status, socioeconomic position, physical activity in leisure time, sedentary behaviours and energy intake | Longitudinal analysis: 5-year incidence Null or NS* associations in all subgroups analyzed (stratified by age and sex) | Self-reported anthropometric data Low retention rate |

*NS: Non statistically significant (P > 0.05).
did not report quantitative estimates of said association (28). Eleven studies collected FFM through a self-administered questionnaire and four by interview. However, none of the studies offered a definition of a family meal, each study’s question was worded differently, the required criteria were very heterogeneous (whether the meal was in the family home, sitting at the table or not, and which family members had to be present), and the reference time period varied. Furthermore, some studies asked about the frequency of only certain meals: evening meal/dinner or supper/breakfast or dinner (19,22,24–26). In 40% of the studies (n = 6), this information was provided by the participants’ parents or guardians, and in one study, either the participants or their parents responded depending on the participant’s age (23). Regarding the degree of adjustment for confounding factors, four studies (three cross-sectional) controlled for the four variable groups considered (age and gender, SEP, physical activity and diet); whereas most of the studies (n = 7) only controlled for two variable groups. Variables least likely to be adjusted for were diet (nine studies) and physical activity (seven studies) related variables.

The majority of studies (73%; n = 11) calculated odds ratios (OR) to estimate the strength of the association between FFM and overweight or obesity (11–13,17,19–21,24–27). One study described differences in obesity prevalence between FFM categories (23) and the other three calculated the regression coefficient for FFM in a model with BMI as dependent variable (15,16,22).

Cross-sectional studies (Table 1)

The average response rate of the 11 cross-sectional studies was 72.4% (range: 36–99%). Eight studies (73%) used objective measures of height and weight (11,13,15–17,19,20,22), whereas three used self-reported data (21,23,22). To classify overweight children based on height and weight, four studies used the Centers for Disease Control and Prevention (CDC) (16,20,21,24) growth tables, three studies used the international tables by Cole et al. (11,13,19), the Tokushima tables were in the Japanese study (23) and the national ones in the Korean study.

Of the 11 studies, six reported statistically significant inverse associations between FFM and BMI or being overweight. Of those, only one adjusted its analyses for the aforementioned four groups of potentially confounding factors (Fig. 2) (13). Four were carried out in children, with OR ranging from 0.11 to 0.77 (13,19,21) for those reporting higher FFM. In one of the studies, the association was only significant among non-Hispanic white children (21). The other two studies were carried out in adolescents (15,20). In one of the studies, the OR was 0.36 for those reporting dinner in family 5–7 times a week vs. never (20), while in the other, the association was only significant among girls (15).

Longitudinal studies (Table 2)

The median retention rate of the four longitudinal studies was 65.1% (range: 49–87.5%), with an average follow-up time of 3.5 years. One study measured height and weight (26) whereas three studies used self-reported data (12,25,27). To classify overweight children one study used the Clinical Guidelines for Overweight in Adolescent Preventive Services standards (25) and the other three studies used the CDC growth tables (12,26,27).

The two studies that presented separate results for their cross-sectional and longitudinal analysis reported an inverse cross-sectional association between FFM and obesity risk (only among non-Hispanic white adolescents in one of the studies), which was not confirmed by the longitudinal analyses (12,27). Regarding the two remaining studies, one detected an inverse association between FFM and obesity risk among children (26), with an OR of 0.93 for being overweight after 3 years of follow-up for

| Table 3 Quality assessment of the studies included in the systematic review (n = 15) |
|---------------------------------|---------------------------------|---------------------------------|
| Quality item                | Number of studies n (%)        |
|---------------------------------|---------------------------------|---------------------------------|
| Measured weight and height     | 9 (60)                          |
| Controlling for potential confounding factors: |
| Age or gender                  | 2 (13)                          |
| Age or gender and socioeconomic position | 6 (40)                      |
| Age or gender, socioeconomic position and diet-related variables | 3 (20)                      |
| Age or gender, socioeconomic position, diet and physical activity-related variables | 4 (27)                      |
| Response or retention rate > 70% | 8 (53)                          |
| Information provided by participants | 10 (66.7)                     |
each breakfast or dinner eaten together as a family. The last study failed to find any kind of association among its adolescent population (25). This study, besides having the longest follow-up period (5 years), was the only one that adjusted its analyses for diet-related variables, including energy intake (Fig. 2).

Figure 2 also shows that 3 out of 4 studies adjusting for the four groups of potentially confounding factors did not find statistically significant associations between FFM and overweight. In addition, the majority of studies that found statistically significant results (6 out of 7) failed to adjust for physical activity- or diet-related variables.

**Discussion**

Our results show that the evidence regarding the relationship between FFM and reduced risk of childhood and adolescent overweight is still limited. Fifteen articles were included in our review. Six out of 11 cross-sectional studies and 1 out of 4 longitudinal studies found statistically significant inverse associations between FFM and overweight. In addition, the original studies suffer from two major limitations: (i) lack of a standard definition of a family meal (at home or away from home, sitting at the table or not, and number and degree of familial relationship of the diners); and (ii) scarce information on the characteristics of the family meals (meal time length, food nutritional quality, TV viewing). Therefore, further research is needed, preferably using longitudinal studies with good adjustment for potential confounders from which draw conclusions about the potential relationship between FFM and overweight in children and adolescents.

Family meals are associated with greater fruit and vegetable consumption and lower consumption of foods high in calories (5,29), better family cohesion and reduction of behavioural problems (30,31). Time dedicated to family meals helps children to establish additional healthy routines such as limiting TV viewing time, eating breakfast regularly or avoiding snacking between meals (19,20,22). In addition, it gives parents the opportunity to serve as models of healthy eating habits. It is not clear, however, whether these benefits translate into a lower obesity risk (32). In this review, most of the cross-sectional studies showed an inverse association between FFM and BMI or overweight, although this finding was more consistent among children than among adolescents, with OR ranging from 0.11 to 0.77 for those reporting higher FFM. This association was also observed in one longitudinal study, with a lower magnitude (OR = 0.93); albeit the one with the lowest retention rate, but also the only one that did not include adolescents and measured the children’s height and weight (26). In the meta-analysis of Hammons et al. (14), which included eight original studies on the association between FFM and overweight, this only study (26) pulled the global estimate to the significant direction. However, of the three remaining longitudinal studies, two found associations in cross-sectional analyses but not in longitudinal ones. Additionally, the longitudinal study with the longest follow-up time (5 years) and the only one that adjusted for all four control variable groups considered in our evaluation did not detect any association among adolescents after stratifying for sex and age (25). A possible interpretation of the lack of association in adolescents is that they avoid family meals as a way of dieting.

The magnitude of the association identified after 3 years of follow-up (26) was considerably smaller.
than the one observed in cross-sectional studies (13,15,17,19–21). Gable et al. chose the more stringent 95th percentile cut-off point for overweight instead of the 85th percentile used by most studies, which may have contributed to weaken the effect. Still, the relationship was statistically significant on a large, US nationwide study sample. Thus, despite its moderate effect size, it may be relevant to public health as overweight affects about 1 out of 3 children in countries like Spain or the United States (33). As a whole, the review’s findings denote that the potential protective effect of family meals may be limited to younger children (4–7-year-olds), which is consistent with the evidence showing that it is the age when dietary behaviours are developed (6,34). Moreover, there is a trend towards lower FFM and decreasing family time as children enter adolescence (29).

One of the three longitudinal studies with adolescent samples found an inverse association between FFM and overweight that approached significance among middle-school girls (25). Goldfield et al.’s recent study, designed to examine this age and gender interaction among adolescents, confirmed the observed relationship (15). Although in need of further study, this potential association could reflect the greater tendency among adolescent females, compared to males, to suffer eating disorders such as binge eating and dieting, which are linked to a greater obesity risk (35–37), but which could be prevented by having family meals (38).

In two studies, family meals were associated with lower obesity risk among higher white children and adolescents but not among Hispanics (21,27). This could reflect the greater nutritional value of the meals and the time spent during family meals promoting healthy eating habits in higher socioeconomic households with highly educated parents (39). Based on cross-sectional analyses of a 93% non-Hispanic white children sample at baseline, Taveras and colleagues (12) found an inverse association between FFM and overweight. However, this was the only longitudinal study that failed to adjust for any socioeconomic position indicator, which is directly related to FFM (16,29) and inversely related to obesity (40). These results suggest that future investigations must examine the effect of race/ethnicity on the potential benefit of family meals, adjusting for socioeconomic position.

Although many studies measured height and weight, others drew on parent-reported or self-reported data, which tend to overestimate height and underestimate weight (41,42). In addition, classification scales and cut-off points defining overweight varied across studies, which difficults results comparison (43). However, the main limitation of the original studies is the measurement of the independent variable of interest, the frequency of family meals, as summarized in Table 4. FFM was evaluated based on self-administered questionnaires or interviews that varied across studies. The most common question was how often or how many days all or the majority of family members ate together in the last week or in a ‘typical week’, or during the last 5 school days (19–22,24,25). But some studies enquired about the general frequency of family meals (giving respondents the option of vague answers, e.g. some days, most days or a few times a week) (11,16,17,23). Some questions asked specifically about breakfast and/or dinner (12,26). In some studies, in order to qualify as family meal, it was sufficient if ‘other family members, some family members or one of the parents’, sat together at the table to share a meal (12,19,24,26). Further, none of the studies defined what was meant by family meal nor took into account the mechanisms through which family meals may potentially affect obesity such as the length of the meal (44), nutritional value or whether the family watched television during the meal (39).

Although some of the studies did adjust for the number of hours children spent watching TV (11,16,19,26), none examined whether TV viewing took place during the meals. This variable is important due to the evidence suggesting that it increases the risk of obesity in children and adolescents (45) even after adjusting for total TV viewing time (46). Several mechanisms explaining this effect have been described. First, eating while watching TV disrupts the body’s signals of fullness, which leads to a greater caloric intake among children (47,48) while reducing the amount of fruits and vegetables available at the table (49). Second, exposure to the food industry advertisements while eating is associated with a lower dietary quality in children and adolescents (48,50). And, finally, having the TV turned on disrupts communication among family members thus reducing the chances of instilling healthy eating habits into the youngest in the family (51). In sum, keeping the TV on while eating could counteract the potential protective effect of family meals on obesity risk (49).

In conclusion, the evidence on the association between FFM and risk of childhood overweight is still weak and inconsistent. Consequently, further research is needed, preferably in the form of longitudinal or experimental studies with clear and standardized definitions of family meals. Meal-related information should be considered such as length of...
the meal, its dietary composition, location and TV viewing during the meal. In addition, it would be highly desirable to evaluate family meals through direct observation or validated questionnaires. Analyses should be adjusted for the most relevant confounding variables such as physical activity and sedentarism, energy consumption, socioeconomic position and race/ethnicity. Finally, it would be valuable to simultaneously study various interrelated eating behaviours such as skipping breakfast and the daily meal frequency, within a suitable theoretical framework (52).

Table 4 Main limitations regarding frequency of family meals measurement and suggestions for future research

| Limitations                                                                 | Suggestions                                                                 |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Lack of standardization of what is considered a family meal, regarding:    | Establish a standard definition of family meal, including any of the main meals wherever is eaten, and specifying who has to be present. |
| Where the meal is eaten (at home? sitting on the table?)                   | Evaluate family meals through direct observation or validated questionnaires applied to the participants by trained interviewers whenever possible. |
| Which and how many members have to be present                              | When using questionnaires, measure the usual number of family meals during a typical week for a specified period of time, preferably last year, to take into account daily and seasonal variability. |
| What meals are considered (dinner, breakfast, both or all)                 | Collect detailed information about key components of family meals and other relevant confounding factors. Regarding TV use, in addition to the total watching TV time, is important to know whether TV viewing takes place during the meals because this habit could counteract the potential benefit of family meals on obesity risk. |
| Variability in the method of measurement, regarding:                      |                                                                           |
| The tool applied (self-administered questionnaire or interview)            |                                                                           |
| The respondents (participants or their parents)                           |                                                                           |
| The reference period used (last week, typical week, last 5 school days, undefined) |                                                                           |
| The measurement unit of frequency (number of days, some days, a few times a week) |                                                                           |
| Lack of information regarding key components of family meals and other relevant confounding factors: |                                                                           |
| Meal length                                                                |                                                                           |
| Nutritional value                                                          |                                                                           |
| Whether the family is watching TV while eating                             |                                                                           |
| Socio-demographic characteristics                                           |                                                                           |
| Physical activity- and diet-related variables                              |                                                                           |

Conflict of Interest Statement

No conflicts of interest declared by the authors.

Author contributions

MAR conceived the review. JV and MAR wrote the draft of the manuscript. All authors were involved in writing the final paper and had approval of the submitted and published versions.

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References

1. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. *Obes Rev* 2004; 1: 4–104.
2. de OM, Blossner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr* 2010; 92: 1257–1264.
3. Monasta L, Batty GD, Cattaneo A, et al. Early-life determinants of overweight and obesity: a review of systematic reviews. *Obes Rev* 2010; 11: 696–708.
4. Birch LL, Ventura AK. Preventing childhood obesity: what works? *Int J Obes (Lond)* 2009; 33: S74–S81.
5. Gillman MW. Family dinner and diet quality among older children and adolescents. *Arch Fam Med* 2000; 9: 235–240.
6. Birch LL. Development of food acceptance patterns in the first years of life. *Proc Nutr Soc* 1998; 57: 617–624.
7. Eisenberg ME, Olson RE, Neumark-Sztainer D, Story M, Bearinger LH. Correlations between family meals and psychosocial well-being among adolescents. *Arch Pediatr Adolesc Med* 2004; 158: 792–796.

8. Franko DL, Thompson D, Affenito SG, Barton BA, Striegel-Moore RH. What mediates the relationship between family meals and adolescent health issues. *Health Psychol* 2008; 27: S109–S117.

9. Neumark-Sztainer D, Wall M, Story M, Fulkerson JA. Are family meal patterns associated with disordered eating behaviors among adolescents? *J Adolesc Health* 2004; 35: 350–359.

10. Nicklas TA, Morales M, Linares A, et al. Children's meal patterns have changed over a 21-year period: the Bogalusa Heart Study. *J Am Diet Assoc* 2004; 104: 753–761.

11. Mamun AA, Lawlor DA, O'Callaghan MJ, Williams GM, Najman JM. Positive maternal attitude to the family eating together decreases the risk of adolescent overweight. *Obes Res* 2005; 13: 1422–1430.

12. Taveras EM, Rifas-Shiman SL, Berkey CS, et al. Family dinner and adolescent overweight. *Obes Res* 2005; 13: 900–906.

13. Vaugelers PJ, Fitzgerald AL. Prevalence of and risk factors for childhood overweight and obesity. *CMAJ* 2005; 173: 607–613.

14. Hammons AJ, Fiese BH. Is frequency of shared family meals related to the nutritional health of children and adolescents? *Pediatrics* 2011; 127: e1565–e1574.

15. Goldfield GS, Murray MA, Buchholz A, et al. Family meals and body mass index among adolescents: effects of gender. *Appl Physiol Nutr Metab* 2011; 36: 539–546.

16. Bauer KW, Neumark-Sztainer D, Fulkerson JA, Hannan PJ, Story M. Familial correlates of adolescent girls' physical activity, television use, dietary intake, weight, and body composition. *Int J Behav Nutr Phys Act* 2011; 8: 25–35.

17. Lee HA, Lee WK, Kong KA, et al. The effect of eating behavior on being overweight or obese during preadolescence. *J Prev Med Public Health* 2011; 44: 226–233.

18. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol* 2009; 62: e1–34.

19. Anderson SE, Whitaker RC. Household routines and obesity in US preschool-aged children. *Pediatrics* 2010; 125: 420–428.

20. Fulkerson JA, Kubik MY, Story M, L tyte L, Arcan C. Are there nutritional and other benefits associated with family meals among at-risk youth? *J Adolesc Health* 2009; 45: 389–395.

21. Rollins BY, Belue RZ, Francis LA. The beneficial effect of family meals on obesity differs by race, sex, and household education: the national survey of children’s health, 2003–2004. *J Am Diet Assoc* 2010; 110: 1335–1339.

22. Utter J, Scrugg R, Schaaf D, Mhurchu CN. Relationships between frequency of family meals, BMI and nutritional aspects of the home food environment among New Zealand adolescents. *Int J Behav Nutr Phys Act* 2008; 5: 50–57.

23. Yuasa K, Sei M, Takeda E, et al. Effects of lifestyle habits and eating meals together with the family on the prevalence of obesity among school children in Tokushima, Japan: a cross-sectional questionnaire-based survey. *J Med Invest* 2008; 55: 71–77.

24. Woodruff SJ, Hanning RM. Associations between family dinner frequency and specific food behaviors among grade six, seven, and eight students from Ontario and Nova Scotia. *J Adolesc Health* 2009; 44: 431–436.

25. Fulkerson JA, Neumark-Sztainer D, Hannan PJ, Story M. Family meal frequency and weight status among adolescents: cross-sectional and 5-year longitudinal associations. *Obesity (Silver Spring)* 2008; 16: 2529–2534.

26. Gable S, Chang Y, Krull JL. Television watching and frequency of family meals are predictive of overweight onset and persistence in a national sample of school-aged children. *J Am Diet Assoc* 2007; 107: 53–61.

27. Sen B. Frequency of family dinner and adolescent body weight status: evidence from the national longitudinal survey of youth, 1997. *Obesity (Silver Spring)* 2006; 14: 2266–2276.

28. Kuriyan R, Thomas T, Sumithra S, et al. Potential factors related to waist circumference in urban South Indian children. *Indian Pediatr* 2012; 49: 124–128.

29. Neumark-Sztainer D, Hannan PJ, Story M, Croll J, Perry C. Family meal patterns: associations with sociodemographic characteristics and improved dietary intake among adolescents. *J Am Diet Assoc* 2003; 103: 317–322.

30. Fulkerson JA, Neumark-Sztainer D, Story M. Adolescent and parent views of family meals. *J Am Diet Assoc* 2006; 106: 526–532.

31. Neumark-Sztainer D, Larson NI, Fulkerson JA, Eisenberg ME, Story M. Family meals and adolescents: what have we learned from Project EAT (Eating Among Teens)? *Public Health Nutr* 2010; 13: 1113–1121.

32. Berge JM. A review of familial correlates of child and adolescent obesity: what has the 21st century taught us so far? *Int J Adolesc Med Health* 2009; 21: 457–483.

33. Lobstein T, Frelut ML. Prevalence of overweight among children in Europe. *Obes Rev* 2003; 4: 195–200.

34. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics* 1998; 101: 539–549.

35. Fulkerson JA, Story M, Mellin A, Leffert N, Neumark-Sztainer D, French SA. Family dinner meal frequency and adolescent development: relationships with developmental assets and high-risk behaviors. *J Adolesc Health* 2006; 39: 337–345.

36. Haines J, Kleinman KP, Rifas-Shiman SL, Field AE, Austin SB. Examination of shared risk and protective factors for overweight and disordered eating among adolescents. *Arch Pediatr Adolesc Med* 2010; 164: 336–343.
37. Neumark-Sztainer DR, Wall MM, Haines JI, Story MT, Sherwood NE, van den Berg PA. Shared risk and protective factors for overweight and disordered eating in adolescents. *Am J Prev Med* 2007; 33: 359–369.

38. Neumark-Sztainer D, Eisenberg ME, Fulkerson JA, Story M, Larson NI. Family meals and disordered eating in adolescents: longitudinal findings from project EAT. *Arch Pediatr Adolesc Med* 2008; 162: 17–22.

39. Patrick H. A review of family and social determinants of children's eating patterns and diet quality. *J Am Coll Nutr* 2005; 24: 83–92.

40. Wang Y. Cross-national comparison of childhood obesity: the epidemic and the relationship between obesity and socioeconomic status. *Int J Epidemiol* 2001; 30: 1129–1136.

41. Nyholm M. The validity of obesity based on self-reported weight and height: implications for population studies. *Obesity (Silver Spring)* 2007; 15: 197–208.

42. Sherry B. Accuracy of adolescent self-report of height and weight in assessing overweight status: a literature review. *Arch Pediatr Adolesc Med* 2007; 161: 1154–1161.

43. Rolland-Cachera MF. Childhood obesity: current definitions and recommendations for their use. *Int J Pediatr Obes* 2011; 6: 325–331.

44. Cassimos D, Sidiropoulos H, Batzios S, Balodima V, Christoforidis A. Sociodemographic and dietary risk factors for excess weight in a Greek pediatric population living in Kavala, Northern Greece. *Nutr Clin Pract* 2011; 26: 186–191.

45. Wiecha JL, Peterson KE, Ludwig DS, Kim J, Sobol A, Gortmaker SL. When children eat what they watch: impact of television viewing on dietary intake in youth. *Arch Pediatr Adolesc Med* 2006; 160: 436–442.

46. MacFarlane A, Cleland V, Crawford D, Campbell K, Timperio A. Longitudinal examination of the family food environment and weight status among children. *Int J Pediatr Obes* 2009; 4: 343–352.

47. Brunstrom JM, Mitchell GL. Effects of distraction on the development of satiety. *Br J Nutr* 2006; 96: 761–769.

48. Halford JC, Boyland EJ, Hughes G, Oliveira LP, Dovey TM. Beyond-brand effect of television (TV) food advertisements/commercials on caloric intake and food choice of 5–7-year-old children. *Appetite* 2007; 49: 263–267.

49. Fitzpatrick E, Edmunds LS, Dennison BA. Positive effects of family dinner are undone by television viewing. *J Am Diet Assoc* 2007; 107: 666–671.

50. Feldman S, Eisenberg ME, Neumark-Sztainer D, Story M. Associations between watching TV during family meals and dietary intake among adolescents. *J Nutr Educ Behav* 2007; 39: 257–263.

51. Fiese BH, Winter MA, Botti JC. The ABCs of family mealtimes: observational lessons for promoting healthy outcomes for children with persistent asthma. *Child Dev* 2011; 82: 133–145.

52. Mesas AE, Munoz-Pareja M, Lopez-Garcia E, Rodriguez-Artalejo F. Selected eating behaviours and excess body weight: a systematic review. *Obes Rev* 2012; 13: 106–135.

**Supporting Information**

Additional Supporting Information may be found in the online version of this article:

**Table S1** PRISMA checklist.

**Table S2** Complete search strategy on PubMed database.