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Quality Matters: A Meta-Analysis on Components of Healthy Family Meals

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Objective: A greater frequency of family meals is associated with better diet quality and lower body mass index (BMI) in children. However, the effect sizes are small, and it remains unclear which qualitative components of family meals contribute to these positive health outcomes. This meta-analysis synthesizes studies on social, environmental, and behavioral attributes of family meals and identifies components of family meals that are related to better nutritional health in children. ***Method:*** A systematic literature search (50 studies; 49,137 participants; 61 reported effect sizes) identified 6 different components of healthy family mealtimes. Separate meta-analyses examined the association between each component and children's nutritional health. Age (children vs. adolescents), outcome type (BMI vs. diet quality), and socioeconomic status (SES; controlled vs. not controlled for SES) were examined as potential moderators. ***Results:*** Positive associations consistently emerged between 5 components and children's nutritional health: turning the TV off during meals ($r = .09$), parental modeling of healthy eating ($r = .12$), higher food quality ($r = .12$), positive atmosphere ($r = .13$), children's involvement in meal preparation ($r = .08$), and longer meal duration ($r = .20$). No moderating effects were found. ***Conclusions:*** How a family eats together shows significant associations with nutritional health in children. Randomized control trials are needed to further verify these findings. The generalizability of the identified mealtime components to other contexts of social eating is also discussed.

Keywords: child, body mass index, diet, family meals, meta-analysis

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The increasing prevalence of overweight and obesity worldwide, especially in children, is *the* public health challenge of modern times. In the United States, for example, more than 18% of children and adolescents are obese (Hales, Carroll, Fryar, & Ogden, 2017). One of the major drivers of obesity is an unbalanced diet (Rosenheck, 2008). Children in particular eat more sugar and fewer fruits and vegetables than recommended (Hebestreit et al., 2017). Because two thirds of children's daily calories stem from food prepared at home (Poti & Popkin, 2011), family meals offer a promising entry point for change. Parents govern the variety (or lack thereof) in their children's food; they guide and, through their own eating behavior, model food intake (Savage, Fisher, & Birch, 2007). In so doing, they shape the development of their children's eating habits and food preferences. Despite demographic and lifestyle changes, U.S. families still have on average 5.1 family meals per week (Saad, 2013), and each shared meal presents a potential learning opportunity (Fiese & Schwartz, 2008). It is therefore important to understand the role that family meals and their behavioral correlates can play in preventing childhood overweight and obesity (for reasons of simplicity, in what follows, all minors are generally referred to as "children," unless an explicit contrast is being drawn between children and adolescents).

Dallacker, Hertwig, and Mata (2018) recently conducted a meta-analysis on the relationship between the quantity of family meals and children's nutritional health. They analyzed 57 studies and found that a greater frequency of family meals was significantly associated with lower body mass index (BMI; $r = -.05$), more healthy eating ($r = .10$), and less unhealthy eating ($r = -.04$) in children. These results suggest two conclusions: First, the frequency of family meals is positively related to children's better diet quality and healthier BMI. Second, the potential impact of the quantity of family meals per se on children's nutritional health appears to be quite small. The meta-analysis by Dallacker et al. focused on the frequency of family meals. However, what makes family meals healthy—that is, what happens during these meals that promotes children's health—is an open question.

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Family systems theory (Cox & Paley, 1997) suggests that family functioning, including family cohesion as well as supportive and warm family interactions, are key factors in promoting health behavior in children (Kitzman-Ulrich et al., 2010). Meaningful rituals such as family meals may therefore play an important role in family functioning, because they have the potential to provide structure and a supportive emotional climate (Spagnola & Fiese, 2007). Thus, spending time with family members provides an opportunity for both positive and negative interactions. Thus, the quality of how families eat together might play an even more important role than does the mere quantity of family meals. In their review, Kitzman-Ulrich et al. (2010) found that a positive family system can promote healthy eating through role modeling and providing social support, healthy foods, and a positive climate for health behavior change. Furthermore, a number of recent studies have investigated how various components of family meals relate to children's nutritional health; for instance, when families enjoy eating together, children are less likely to be overweight (e.g., Berge et al., 2014). Yet findings on the effects of specific family meal components are mixed. Some studies have found that children's nutritional health is better when the TV is turned off during family meals (e.g., Roos et al., 2014); others have found no such effect (e.g., van Zutphen, Bell, Kremer, & Swinburn, 2007). Or consider the prominent hypothesis that longer meal duration increases the amount of food eaten (de Castro, 1994). Contrary to this hypothesis, children who spend less time at the dinner table are more likely to be overweight (Jacobs & Fiese, 2007).

Further complicating matters, reviews of the effects of various family meal components have lacked quantitative stringency. Specifically, narrative reviews of the literature (e.g., Fulkerson, Larson, Horning, & Neumark-Sztainer, 2014; Martin-Biggers et al., 2014) have suggested that different mealtime components may be beneficial for children's nutritional health, but the reviews were not systematic, nor did they quantify effect sizes or focus explicitly on family meals (e.g., Pearson, Biddle, & Gorely, 2009). The current meta-analysis is therefore an important next step toward understanding how and how strongly the quality of a family meal—that is, its specific components—relates to children's nutritional health.

The goal of this meta-analysis was to identify components of family meals that are potentially beneficial for children's nutritional health. These components were defined as social, environmental, and behavioral attributes of family meals, including food quality, that have the potential to influence two outcomes: to facilitate a healthy body weight and to boost children's diet quality. The strength of the relationship between a mealtime component and children's nutritional health may depend on the type of outcome. For instance, body mass index (BMI) is influenced not only by eating and related factors but also by physical activity (Hruby et al., 2016); stronger effects were therefore expected for diet quality than for BMI. Characteristics of the study population such as age and socioeconomic status may also influence the effect of a mealtime component. Adolescents' eating behavior is more strongly influenced by peers, school, media, or cultural norms than is that of younger children (Story, Neumark-Sztainer, & French, 2002). Thus, the influence of family meals may decrease as children get older. Lower socioeconomic status (SES) has been linked to poorer diet and a higher risk of overweight (Appelhans et al., 2012; Morgenstern, Sargent, & Hanewinkel, 2009). Families with a lower socioeconomic status also report more family chaos and less frequent family meals. Consequently, the potential positive effect of a mealtime component may be lower in families with a lower SES.

Three research questions were addressed: (a) What are frequently investigated family mealtime components in observational studies that assessed the relationship between one (or more) components and nutritional health in children? (b) How strong is the relationship between the identified mealtime components and children's nutritional health? and (c) Do age of the target population (children vs. adolescents), outcome type (BMI vs. diet quality), and SES (controlled vs. not controlled for SES) moderate the association between different mealtime components and children's nutritional health?

Method

This meta-analysis complies with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009). The PRISMA checklist is available in the online supplemental materials.

Search Strategy

The search strategy was developed by the authors and reviewed by an independent research librarian who specialized in systematic literature search in the social sciences. This resulted in a three-step search strategy. First, a systematic literature search was conducted using search terms in the following databases:

Web of Science: ("family meal" OR "mealtime*" OR "shared meal" OR "dinner") AND ("BMI" OR "body mass index" OR "overweight" OR "obesity" OR "food intake" OR "eat*" OR "diet" OR "nutrition" [Refined by topic "child*" OR "adolescent*" OR "young adults"]),

PubMed (Medical Subject Headings [MeSH]): (("Diet" OR "feeding behavior") AND "family" [Filter: "preschool child," "child," "adolescent"]), and

PsycINFO: ("body mass index" OR "body weight" OR "obesity" OR "overweight" OR "diets" OR "eating behavior" OR "food" OR "food preferences" OR "nutrition") AND ("mealtimes" [Thesaurus] OR "meal*" OR "dinner" OR "lunch").

The exact search terms differed between databases depending on whether free or controlled vocabulary was used (i.e., MeSH terms in Pubmed; Thesaurus in PsycINFO). There was no restriction on the year of publication. Unpublished studies (e.g., dissertations, conference abstracts) written in English or German were also included in the analysis. Second, forward searches were performed on relevant studies found in the literature search, with Web of Science being used to identify later articles that cited them. Third, backward searches were performed on literature reviews; that is, their reference lists were reviewed. Throughout, the key terms used were selected to cast a wide net and identify studies that did not necessarily include mealtime components in their title or abstract. This procedure is likely to have increased the probability of including studies with nonsignificant results.

Screening for Eligibility

Studies had to meet three criteria to be included. They had to (a) examine at least one component of the family mealtime, (b) include one indicator of nutritional health that was child- or adolescent-focused, and (c) report one bivariate statistical association between the relevant component and indicators of nutritional health. Studies were excluded if they focused on a specific population that had feeding problems or required a special diet (e.g., children with diabetes). Manifestly irrelevant studies (e.g., focusing on animals, older adults, or eating disorders) were excluded. For all other studies, the full text was screened to determine eligibility. Figure 1 shows a PRISMA flow diagram (cf. Moher et al., 2009) of the screening process. To establish interrater reliability, the first author and a trained research assistant screened approximately 30% of the articles against the criteria just discussed. Because the agreement rate (Cooper, Hedges, & Valentine, 2009) was very high (90%–95%), the remaining 70% of articles were processed independently by one rater. Any screening issues were discussed and resolved with the second and third authors.

Categorization of Components

There is no objective criterion defining the number of studies needed to conduct a meta-analysis. We used the threshold of five or more studies for random-effects meta-analyses as suggested by Jackson and Turner (2017). Mealtime practices that represent a summary score of more than one component (e.g., "negative mealtime practices," composed of watching TV, eating fast food, and leaving the table during meals; McCurdy, Gorman, Kisler, & Metallinos-Katsaras, 2014) were not included in this meta-analysis, because they do not allow for estimating the effect of a specific mealtime component.

Coding of Studies

Studies were coded on the following dimensions according to established guidelines (Card, 2011):

- Sample characteristics: demographic features (ethnic composition, age), sample size;
- Measurement characteristics: source of information (child, parent report, observer) and type and description of measure used (nutritional health and component);
- Design characteristics: cross-sectional versus longitudinal;
- Source characteristics: author, year of study, publication type; and
- Study quality: study design, convenience sampling, specific subpopulation, reliability and validity of relevant measures, response rate (participation rate at least 50%), and pilot testing of survey instruments.

An adapted version of the data extraction form developed and tested within a meta-analysis on family meal frequency (Dallacker et al., 2018) was used. Data were extracted by the first author, and each data point was independently checked by a trained research assistant. Disagreements were resolved by discussion with the second and third authors.

Outcome: Nutritional Health

This meta-analysis focuses on two outcomes that are frequently investigated by studies on family meals: BMI and diet quality. BMI is an indirect measure of body fat and obesity, both of which are linked to serious health conditions such as diabetes. It is influenced by not only what but also how a person eats (e.g., speed of eating, food quantity; J. O. Hill, Wyatt, & Peters, 2012; Nagahama et al., 2014), thereby providing information that is complementary to diet quality, the average consumption of foods that are related to obesity. It is important to note that BMI does not distinguish between fat and muscle mass (Rothman, 2008). Further, BMI is just one of several risk factors for chronic degenerative diseases, and its effects can be offset by lifestyle factors (e.g., Bombak, 2014). Therefore, the current meta-analysis also included studies that assessed diet quality. This includes healthy/nutrient-dense foods (e.g., fruits, vegetables), unhealthy/energy-dense foods (e.g., soda, sweet and salty snacks), and summary scores of healthy and/or unhealthy foods (e.g., the Healthy Eating Index). Like BMI, diet quality is an important predictor of health. Better diet quality can protect against heart disease and other chronic diseases (Aune et al., 2017). BMI and diet quality are both health-related variables that can be influenced through nutrition-related behavior during family meals. Consequently, effect sizes are reported both separately for BMI and diet quality and combined into one factor: nutritional health.

Effect Size

The correlation coefficient r was chosen as an effect size of the associations between component of family mealtime and nutritional health for several reasons: Many of the studies reported r values; they can be computed from a wide range of statistics, most measures were continuous (or artificially dichotomized), and r is easily interpretable. The results were coded such that a positive r indicates that a component is positively associated with better nutritional health. To be consistent for all variables, the direction of the r value was reversed for BMI and unhealthy/energy dense foods or if negative mealtime components were analyzed (e.g., watching TV instead of TV off). If available, unadjusted r values were used. If r values were not available but standardized beta values were, those were used (Becker & Wu, 2007; Peterson & Brown, 2005). Other statistics, such as t test or odds ratios, were converted into r values (Borenstein, Hedges, Higgins, & Rothstein, 2009; Card, 2011). If a study did not report sufficient statistics to calculate an r value, the authors were contacted up to two times. Seven of the 15 authors contacted responded.

Artifact Corrections

Dichotomizing a continuous variable attenuates its association with other variables (Card, 2011). Because some of the primary studies included may be affected by this artifact, r was corrected whenever continuous variables were dichotomized (e.g., when BMI was measured but the analysis was based on the BMI categories "normal" vs. "overweight"; for details, see Hunter & Schmidt, 2004, p. 36).

Data Synthesis: Estimating Overall Effect Sizes for Mealtime Components

A separate meta-analysis was conducted for each component identified. Furthermore, r values were transformed using variance-stabilizing Fisher's z transformation (Borenstein et al., 2009), and

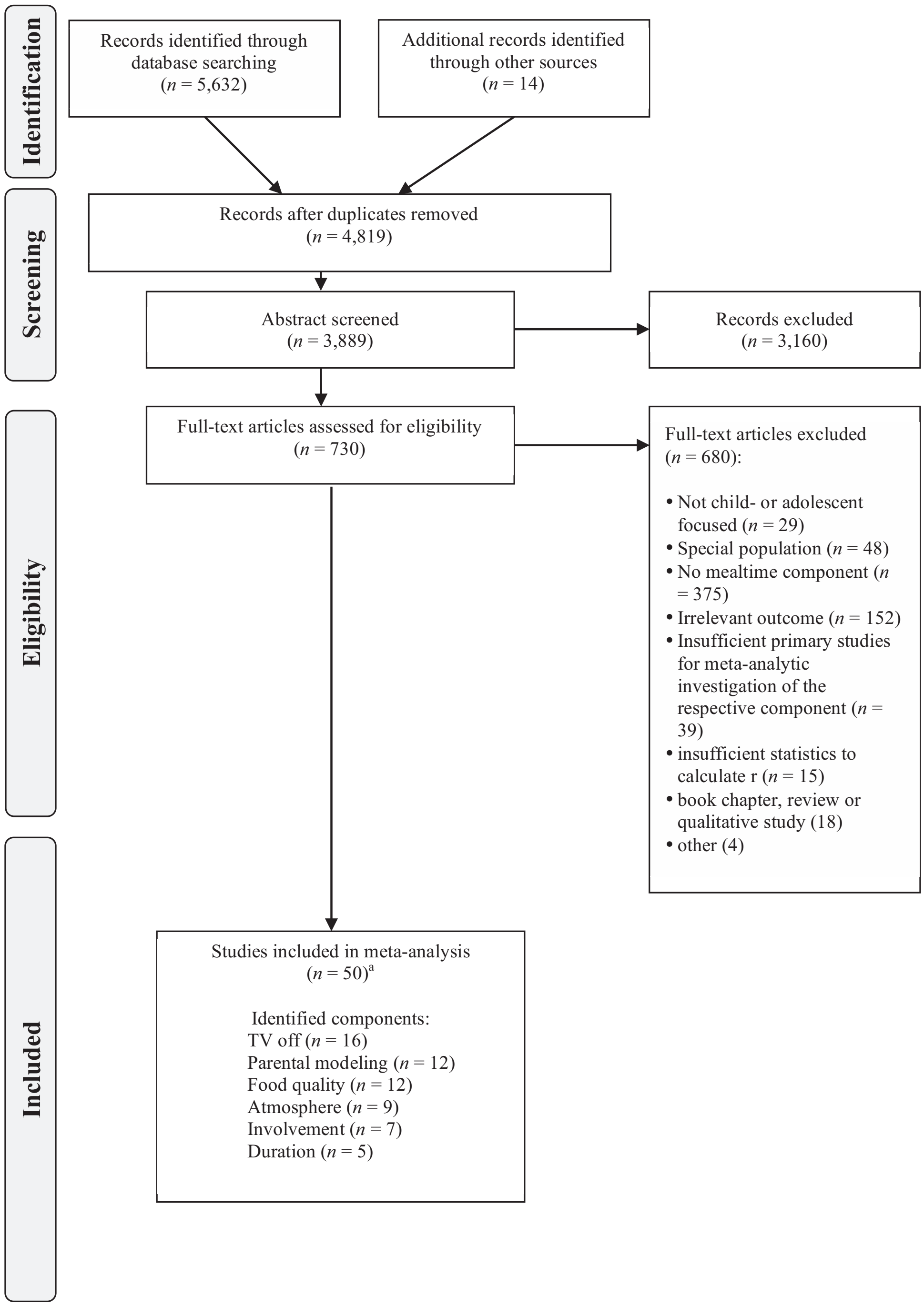

Figure 1. PRISMA flow diagram documenting how articles were identified for the meta-analysis. *n* indicates the number of studies. [a]Some of the studies included in the meta-analysis reported more than one mealtime component: $n = 41$ examined one component, $n = 5$ examined two, and $n = 3$ examined three; accordingly the number of studies included ($n = 50$) is not equal to the sum of the studies addressing each mealtime component.

all analyses used the *r*- to *z*-transformed values. For forest plots and tables, pooled effect sizes were back-transformed to *r* values.

A random-effects-size approach was used to calculate a pooled effect size with 95% confidence intervals (CIs). Random-effects models do not assume a single effect size but a distribution of population effect sizes; consequently, they consider systematic variance between studies (Borenstein et al., 2009). Random-effects models were used because the primary studies differed in how they examined specific components and nutritional health (see the Results section). For each component, a pooled effect size was calculated for BMI, for diet quality, and for nutritional health (i.e., for BMI and diet quality combined).

Heterogeneity

Q tests were calculated to assess the null hypothesis of homogeneity among effect sizes within one mealtime component. A nonsignificant *Q* test indicates that between-studies variance stems from random rather than systematic differences. Heterogeneity was quantified with I^2 statistics indicating the degree of systematic variance between studies (Huedo-Medina, Sánchez-Meca, Marín-Martínez, & Botella, 2006): An I^2 value of 0 means that between-studies variance results from random error; values above 0 indicate the proportion of systematic between-studies variance.

Moderator Analyses

Moderator analyses were conducted to identify conditions under which components have particularly strong effects and to shed light on sources of heterogeneity. Outcome type (BMI vs. diet quality), age of the target population (children vs. adolescents), and SES (controlled vs. not controlled for SES) were examined as potential moderators. Moderator analyses were conducted for only components investigated in more than 10 studies (Borenstein et al., 2009).

Study Quality

Methodological quality was assessed using the following criteria adapted from Card (2011) and Agarwald, Guyatt, and Busse (2019): study design (cross-sectional or longitudinal), convenience sampling, specific subpopulation, reliability and validity of relevant measures, response rate (participation rate at least 50%), and pilot testing of survey instruments. See Table S3 in the online supplemental materials for more details. Primary studies were coded by two independent raters. The moderating effect of the quality sum score was examined for mealtime components featured in 10 or more studies.

Publication Bias

Funnel plots were used to investigate the possibility that studies finding nonsignificant results were less likely to be published. Funnel plots are scatterplots of effect sizes in primary studies and their standard errors; asymmetric funnel plots may indicate publication bias (Light, Singer, & Willet, 1994). Egger's linear regression method was used to test for funnel plot asymmetry. Additionally, the "trim and fill" method was applied to impute suspected missing studies until the studies were symmetrically distributed around the pooled effect size; an adjusted effect size was then computed (Duval & Tweedie, 2000).

Multiple Effect Sizes From Single Studies

Some of the studies reported data from two or more independent subgroups (e.g., girls and boys; low and high SES). In these cases, each subgroup was treated as a separate study, with a pooled effect size being computed for each. Some of the studies reported multiple results for the same sample (e.g., BMI and diet quality). Others shared the same sample but reported on different outcomes. In these cases, a pooled effect size was computed, taking the correlation among the outcomes into account (Borenstein et al., 2009). In cases where both outcome types (BMI and diet quality) were investigated as moderators, separate effect sizes were calculated. All analyses were implemented using the *metafor* package in *R* (Version 3.1.1; Viechtbauer, 2010).

Results

The keyword search yielded 4,819 potentially relevant articles. After screening, 50 studies were included in the meta-analysis (see Figure 1). Table S1 in the online supplemental materials lists the excluded studies and the reasons for their exclusion. The 50 articles included in the meta-analysis are listed in the online supplemental materials.

Components Identified

Six mealtime components were examined in at least five studies and were thus included in the analysis; 61 relevant effect sizes were reported. Specifically, studies examining TV off ($k = 16$) asked participants how often they watched TV during shared meals. Studies assessing parental modeling ($k = 12$) asked whether parents' eating behavior provided a model for the quantity or quality of food consumed—either directly, by asking whether parents modeled healthy food intake at mealtimes (e.g., eating vegetables), or indirectly, by asking whether they ate the same food as did their children during family meals. Studies examining food quality ($k = 12$) asked how often the family ate vegetables, home-cooked meals, fast food takeouts, or at fast food restaurants. Studies examining atmosphere ($k = 9$) assessed the mood during shared meals—some using parental self-reports, others using expert ratings of videotaped family meals. Studies assessing children's involvement in meal preparation ($k = 7$) asked how involved a child was in preparing meals. Finally, studies investigating duration of meals ($k = 5$) assessed how long family meals lasted by measuring the average length of videotaped family meals or by asking whether mealtimes were rushed.

Feeding styles (i.e., parental strategies influencing the amount and type of food consumed by their children) are another important component identified in the literature. However, the studies differed substantially in how they defined and measured feeding styles. Given that most feeding styles include aspects outside the family meal (e.g., snacking behavior), they were not included in this meta-analysis.

Study Characteristics

Beyond mealtime components, the two other key concepts in the literature analysis were family meals and nutritional health. Some studies assessed main meals in general; others assessed dinner, lunch, or breakfast separately. Nutritional health was analyzed in terms of children's BMI or diet quality. BMI was assessed as either a continuous or a categorical (normal weight, overweight, obesity) measure. Diet quality was measured by food-frequency questionnaires assessing the intake of healthy and unhealthy foods either on a continuous scale (e.g., amount of fruits, vegetables, and fast food consumed per day) or as a categorical measure (e.g., whether a child eats five or more portions of fruits and vegetables per day).

In total, 50 studies with a total of 49,137 participants (range = 40–4,072) were analyzed. Of these, 41 studies examined one component, five studies examined two, and three studies examined three. Table 1 summarizes the characteristics of the studies included (for more details, see Table S2 in the online supplemental materials).

Table 1
Characteristics of the Studies Included in the Meta-Analysis by Mealtime Component

Variable and category	TV (*k* = 16)	MO (*k* = 12)	QU (*k* = 12)	AT (*k* = 9)	IN (*k* = 7)	DU (*k* = 5)
Location						
United States, Canada	9	7	10	5	3	4
Europe[a]	2	4	0	2	2	1
Australia	2	1	2	2	2	0
Middle and South America[b]	2	0	0	0	0	0
China	1	0	0	0	0	0
Period of study						
2000–2009	3	1	4	1	2	1
2010–2019	13	11	8	9	4	4
Study design						
Cross-sectional	16	12	10	9	7	4
Longitudinal	0	0	1	0	0	1
Cross-sectional and longitudinal	0	0	1	0	0	0
Child age						
Children (2–10 years)	10	9	5	6	3	5
Adolescents (11–18 years)	6	3	7	3	4	0
Nutritional health outcome assessed						
BMI	5	1	7	5	0	4
Diet quality	10	8	4	3	6	1
BMI and diet quality	1	3	1	1	1	0
Definition of family meal						
Meal (unspecified)	9	9	7	4	4	1
Dinner	7	3	5	4	3	4
Lunch	0	0	0	1	0	0
Mealtime component assessed						
Food quality						
Home-cooked meal			2			
Vegetables at meal			3			
Fast food (takeout or in restaurant)			7			
Parental modeling						
Direct: model healthy eating		9				
Indirect: no special meal for child		3				
Atmosphere						
Expert rating of atmosphere				5		
Parent report of atmosphere				4		
Duration of meals						
Objective (minutes)						4
Subjective (mealtimes are a rush)						1
Controlled for SES						
Yes	7	5	3	1	3	1
No	9	7	9	8	4	4

Note. *k* represents the number of studies. TV = television off; MO = parental modeling; QU = food quality; AT = atmosphere; IN = children's involvement; DU = duration; BMI = body mass index; SES = socioeconomic status.
[a] Netherlands, Norway, United Kingdom, Germany, Italy, Spain, Sweden, Scotland, Bulgaria. [b] Brazil, Puerto Rico.

Association Between Components of Family Meal and Children's Nutritional Health

The following components were significantly associated with better nutritional health: turning the TV off (*r* = .09, 95% CI [.05, .13]), parental modeling of healthy eating habits (*r* = .12, 95% CI [.08, .16]), higher food quality (*r* = .12, 95% CI [.07, .17]), a positive mealtime atmosphere (*r* = .13, 95% CI [.06, .20]), involvement of children in meal preparation (*r* = .08, 95% CI [.04, .13]), and longer meal duration (*r* = .20, 95% CI [.09, .29]). Heterogeneity was large (46%–84%) and significant in all components. Table 2 summarizes statistical details of the meta-analyses, and Figure 2 shows corresponding forest plots.

Publication Bias

Funnel plots for TV off, parental modeling, and children's involvement were roughly symmetrical. The plots for food quality, atmosphere, and meal duration were slightly skewed; however, the adjusted effect sizes were still significant when suspected missing studies were imputed. Therefore, there does not seem to be a serious threat of publication bias (Rothstein, Sutton, & Borenstein, 2005). Statistical details and corresponding funnel plots with trim and filled effect sizes can be found in Figure S1 in the online supplemental materials.

Moderators

For components assessed in more than 10 studies, age of the target population (children vs. adolescents), outcome type (BMI vs. diet quality), and SES (controlled vs. not controlled for SES) were tested as potential moderators. Although studies investigating children reported higher effect sizes than did studies investigating adolescents on the descriptive level, the age of the target population was not a significant moderator (Figure S2 in

Table 2
Meta-Analyses and Moderator Analyses With Subgroups

Mealtime component, moderator, and subgroups	*r*	[95% CI]	*QM*	Overall effect size *r* [95% CI]	I^2
TV off (*k* = 16)				.09 [.05, .13]	68%
Outcome					
Diet quality	.11	[.07, .14]	2.85		
BMI	.05	[−.01, .11]			
Age					
Children	.10	[.05, .15]	.73		
Adolescents	.07	[.01, .13]			
SES					
Controlled	.09	[.03, .15]	.00		
Not controlled	.09	[.04, .14]			
Parental modeling (*k* = 12)				.12 [.08, .16]	68%
Outcome					
Diet quality	.12	[.08, .17]	1.31		
BMI	.07	[−.01, .15]			
Age					
Children	.13	[.09, .17]	1.99		
Adolescents	.07	[.00, .14]			
SES					
Controlled	.10	[.04, .17]	.30		
Not controlled	.13	[.08, .18]			
Food quality (*k* = 12)				.12 [.07, .17]	82%
Outcome					
Diet quality	.17	[.08, .25]	2.00		
BMI	.10	[.04, .15]			
Age					
Children	.14	[.05, .23]	.20		
Adolescents	.12	[.05, .18]			
SES					
Controlled	.16	[.06, .25]	.62		
Not controlled	.11	[.05, .17]			
Atmosphere (*k* = 9)				.13 [.06, .20]	83%
Outcome					
Diet quality	.09	[−.01, .18]			
BMI	.15	[.04, .26]			
Age					
Children	.14	[.05, .23]			
Adolescents	.12	[.00, .24]			
SES[a]					
Controlled					
Not controlled					
Children's involvement (*k* = 7)				.08 [.04, .13]	84%
Outcome[a]					
Diet quality					
BMI					
Age					
Children	.07	[−.01, .15]			
Adolescents	.10	[.03, .16]			
SES					
Controlled	.11	[.04, .19]			
Not controlled	.07	[.01, .12]			
Duration of meals (*k* = 5)[a]				.20 [.09, .29]	46%

Note. Results from mixed effects models. Moderator analyses were calculated for only mealtime building blocks examined in at least 10 studies. *r* is the correlation coefficient; *QM* is the *QM* test of moderators with $c - 1$ degrees of freedom, where *c* is the number of categories in the moderator variable; I^2 is the heterogeneity index; and *k* is the number of samples. CI = confidence interval; BMI = body mass index; SES = socioeconomic status.
[a] Given the low number of studies per subgroup ($k < 2$), pooled effect sizes were not calculated.

the online supplemental materials shows the distribution of effect sizes across all components separately for adolescents and children). In a similar way, studies assessing diet quality reported higher effect sizes than did studies assessing BMI for most components (see Table 2 and Figures S3 and S4 in the online supplemental materials). However, outcome type was not a significant moderator. SES was not a significant moderator of the relationship between components and children's nutritional health; pooled effect sizes did not differ substantially between the two categories.

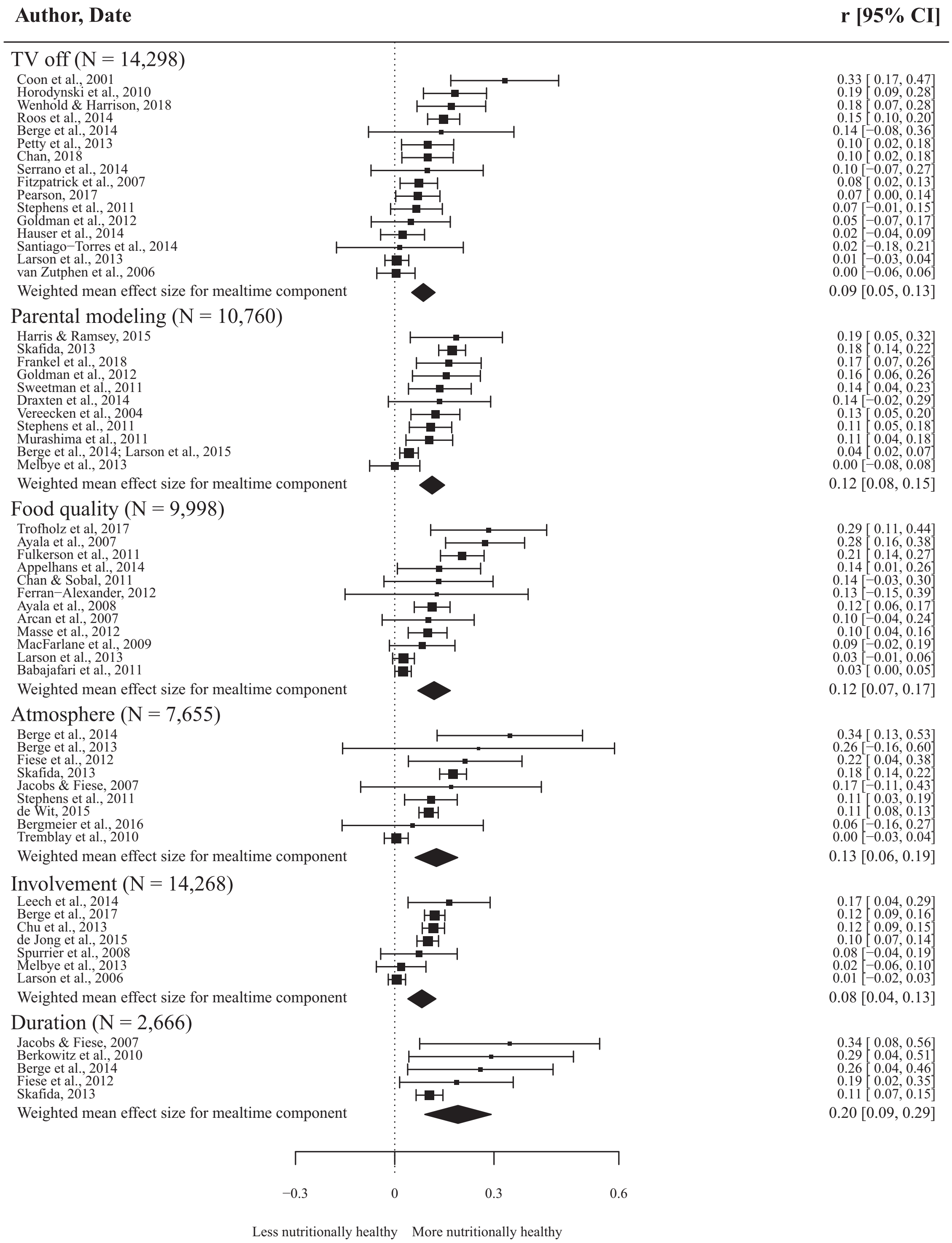

Figure 2. Forest plot showing the distribution of effect sizes for each mealtime component.

Quality Assessment

Study quality was not a significant moderator (fast food: $QM = 2.60$, $p = .108$; role modeling: $QM = .31$, $p = .575$; TV off: $QM = .00$, $p = .98$).

Discussion

This systematic review and meta-analysis identified six social, environmental, and behavioral components of family mealtime that may help to explain why frequent family meals foster children's nutritional health: turning the TV off at mealtimes, better food quality, parental modeling of healthy eating, a positive atmosphere, children's involvement in meal preparation, and longer meal duration. The effect sizes of family meal components were small. How a family eats together thus seems to be at least equally as important as how often. The results suggest that the association between the mealtime components and nutritional health holds above and beyond effects of SES and age. With the exception of studies examining atmosphere as a mealtime component, on a descriptive level, studies with diet quality as outcome showed higher effect sizes compared to studies with BMI as outcome. However, this effect was not significant. It is possible that the statistical power to detect moderator effects was insufficient due to the small numbers of studies included.

Because this meta-analysis aggregated cross-sectional studies, we cannot determine causality. Nevertheless, the findings, in conjunction with other studies on family systems and eating behavior, suggest that the six identified components of family meals may be beneficial for children's nutritional health. Research has shown that families with normal-weight children have higher levels of healthy family functioning compared to families with overweight children (Turner, Rose, & Cooper, 2005). Thus, gathering around the table without distraction from TV, cooking and eating fresh food and involving the child in the process, having positive social interactions, role modeling, and taking time to eat may improve family cohesion and climate.

The findings suggest that sharing family meals according to the six components may increase family functioning, which in turn fosters positive health behavior in children. Additional mechanisms may operate more directly within the mealtime situation and influence children's eating behavior. Such possible mechanisms for each of the six components include the following: Watching TV while eating, for example, impairs the capacity to monitor food intake and attend to satiety cues (Blass et al., 2006). The finding that parental modeling is linked to better nutritional health in children is supported by experimental results showing that children are more likely to eat a new food if an adult role model eats the same type of food (Addessi, Galloway, Visalberghi, & Birch, 2005). The association between a positive mealtime atmosphere and better nutritional health may be explained by the child's being less likely to engage in emotional eating (Wildermuth, Mesman, & Ward, 2013). It is interesting that atmosphere was the only mealtime component for which (on a descriptive level) studies with BMI as outcome showed higher effect sizes compared to studies with diet quality as outcome. A negative mealtime atmosphere might be an indicator of a more general negative family climate, which, according to family systems theory, is a potential risk factor for childhood obesity (Turner et al., 2005). Children who experience self-agency and participatory decision-making in the context of meal preparation may develop a greater interest in nutrition (L. Hill, Casswell, Maskill, Jones, & Wyllie, 1998) and a greater sense of self-efficacy for healthy eating (Chu et al., 2013). Longer meals are associated with lower BMI and better diet quality. It is possible that people who take more time eat at a slower rate permit a sense of satiety to kick in before they have finished (Berkowitz et al., 2010). In addition, longer mealtimes may result in longer intermeal satiety (Andrade, Kresge, Teixeira, Baptista, & Melanson, 2012).

This study has limitations. First, all studies were observational. Confounding variables and alternative explanations cannot be ruled out. For example, the mealtime components might be the result, not the cause, of more positive family functioning and healthier family life. Second, heterogeneity between studies was high. Beyond the moderators investigated, other potential sources of heterogeneity include variability in the definition and operationalization of family mealtimes (e.g., dinner vs. main meal) and variability in how key variables were measured. Due to the limited number of studies to date and the inconsistency across many variables, it was not possible to analyze to what extent these differences mattered. One goal of this meta-analysis was to systematically describe factors such as the high variability across definitions and measures. This provides the basis for eventually reaching scientific consensus on definitions and measures and, consequently, reducing heterogeneity between studies in the future. Third, observed effects are small. Except for meal duration, the effect sizes of the mealtime components are below the generally recommended threshold for a "practically" significant effect ($r = .20$; Ferguson, 2009). However, it is worth keeping in mind that effect sizes in the field of obesity and diet are usually small, because they are influenced by an interplay of environmental, biological, and behavioral factors. Furthermore, even small effect sizes can have a large public health impact. For example, a small weight loss substantially reduces cardiovascular risk factors (Reinehr et al., 2016). The effect sizes we found for the six family mealtime components are in the same range as the effect sizes reported in large observational studies of obesity risk factors, such as skipping breakfast (e.g., the meta-analysis by de la Hunty, Gibson, & Ashwell, 2013). A preregistered protocol and screening 100% of the studies by two independent raters (instead of 30%) could have improved the quality of this meta-analysis even further.

Evidence quality ratings such as GRADE (Grading of Recommendations Assessment, Development, and Evaluation; Guyatt, Oxman, Schünemann, Tugwell, & Knottnerus, 2011) suggest that the quality of evidence for clinical practice is currently very low (due to observational designs, high heterogeneity [high inconsistency], and significant risk of bias in some of the studies; see Table S3 in the online supplemental materials for details). Taken together, the limitations show that, despite the fast-growing research around family meals, this is a still young field. It is important to note that the goal of this meta-analysis is not to provide evidence for clinical practice but to systematize the growing field of family meal research and provide a basis for more coherent, experimental research. The latter will lead to better evidence for clinical practice in the future.

The next step will be to conduct randomized control studies. For example, it has already been shown that a distracting noise during the family meal can decrease children's consumption of healthy foods (Fiese, Jones, & Jarick, 2015). Future studies should focus on specific components, ideally using longitudinal designs and standardized constructs and measures. Also, experimental studies should explore the type of relationship between the mealtime components and children's nutritional health. For meal duration, a U-shaped relationship with both very short and very long meal durations negatively impacting nutritional health could emerge. For other family mealtime components, a linear relationship as assumed in this meta-analysis seems more likely, with, for instance, more role modeling bringing about more beneficial effects.

Understudied mealtime components such as the location of the family meal (Skafida, 2013), the family members present at the table (Sweetman, McGowan, Croker, & Cooke, 2011), or the usage of electronic devices other than TV (Berge et al., 2014) also warrant future research, as do dependencies between components. For example, children's involvement in meal preparation may co-occur with higher food quality and less fast food. Future research should further examine to what extent the components can be transferred to other contexts, such as school or kindergarten. One experimental study has already shown that teachers who model dietary behaviors in the same way as parents function as role models during meals (Hendy & Raudenbush, 2000).

This study has potentially important practical implications. The recommendation that families should eat together more often is widely propagated in the media. The current findings suggest that the beneficial role of family meals may depend substantially on *how* families eat together. Few intervention studies have examined family meals as a means of addressing childhood obesity. First promising results stem from a randomized control intervention (Fulkerson et al., 2015). In this intervention, components of family mealtimes were manipulated by eliminating electronic devices at mealtimes or promoting positive conversations, which led to a reduction in weight gain. If randomized control studies continue to confirm the positive role of the components examined, these insights should be shared with parents and other architects of children's food environments (e.g., teachers). The mealtime components are nonintrusive, actionable boosting interventions (Dallacker, Mata, & Hertwig, 2019; Hertwig & Grüne-Yanoff, 2017); they can be easily communicated, learned, and practiced. This is particularly important because some of the components identified in this meta-analysis are probably in decline because of lifestyle changes such as eating on the go, use of electronic devices during mealtimes, and increasing numbers of dual-earner families (Breaugh & Frye, 2008; Smith, Ng, & Popkin, 2013). The success of communicating positive mealtime components may depend on the finances and time available to commit to the endeavor (Johnson et al., 2010). A pluralistic approach that also targets the convenience and costs of unhealthy and healthy foods (taxes vs. subsidies; Powell & Chaloupka, 2009) may thus be promising.

Given the diversity of modern family structures, the present results should be interpreted in the light of gender equity goals in domestic and workplace demands. Interventions implementing the positive components of family meals should consider these factors. For example, some of the components may generalize across other social meal contexts, such as school canteens. Additionally, digitalization is making office hours and locations more flexible, and some employers now provide cafeterias in which families can eat together.

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