



This postprint was originally published by Elsevier as:  
Knobl, V., Dallacker, M., Hertwig, R., & Mata, J. (2022). **Happy and healthy: How family mealtime routines relate to child nutritional health.** *Appetite*, 171, Article 105939.  
<https://doi.org/10.1016/j.appet.2022.105939>.

Supplementary material to this article is available. For more information see  
<http://hdl.handle.net/21.11116/0000-0009-D1B4-F>

### **Nutzungsbedingungen:**

Dieser Text wird unter einer Deposit-Lizenz (Keine Weiterverbreitung - keine Bearbeitung) zur Verfügung gestellt. Gewährt wird ein nicht exklusives, nicht übertragbares, persönliches und beschränktes Recht auf Nutzung dieses Dokuments. Dieses Dokument ist ausschließlich für den persönlichen, nicht-kommerziellen Gebrauch bestimmt. Auf sämtlichen Kopien dieses Dokuments müssen alle Urheberrechtshinweise und sonstigen Hinweise auf gesetzlichen Schutz beibehalten werden. Sie dürfen dieses Dokument nicht in irgendeiner Weise abändern, noch dürfen Sie dieses Dokument für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Mit der Verwendung dieses Dokuments erkennen Sie die Nutzungsbedingungen an.

### **Terms of use:**

This document is made available under Deposit Licence (No Redistribution - no modifications). We grant a non-exclusive, nontransferable, individual and limited right to using this document. This document is solely intended for your personal, non-commercial use. All of the copies of this documents must retain all copyright information and other information regarding legal protection. You are not allowed to alter this document in any way, to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. By using this particular document, you accept the above-stated conditions of use.

### **Provided by:**

Max Planck Institute for Human Development  
Library and Research Information  
[library@mpib-berlin.mpg.de](mailto:library@mpib-berlin.mpg.de)

# Happy and healthy: How family mealtime routines relate to child nutritional health

Vanessa Knobl <sup>a,\*</sup>, Mattea Dallacker <sup>b</sup>, Ralph Hertwig <sup>b</sup>, Jutta Mata <sup>a,b,c</sup>

<sup>a</sup> School of Social Sciences, Department of Psychology, University of Mannheim, Germany

<sup>b</sup> Center for Adaptive Rationality, Max Planck Institute for Human Development, Germany

<sup>c</sup> Mannheim Center for Data Science, University of Mannheim, Germany

\* Corresponding author. University of Mannheim Chair of Health Psychology, L13, 17, 68131, Mannheim, Germany.

E-mail address: [knobl@uni-mannheim.de](mailto:knobl@uni-mannheim.de)

---

**Keywords:** Child, Parent, Family meal, Mealtime routines, Nutrition, Eating

---

## Abstract

Children eat most of their meals in a family context, making family meals a key environment in which to learn about healthy food. What makes a family meal “healthy”? This diary study examined the practice of seven family mealtime routines (e.g., positive mealtime atmosphere, parental modeling, and longer meal duration) and their predictive value for children’s healthier nutrition focusing on everyday family meal settings.

Over 7 consecutive days, parents from  $N = 310$  families ( $M_{age} = 42$  years) described their most important family meal of the day and food intake for an index child ( $M_{age} = 9$  years) and indicated what mealtime routines were practiced during the family meal. On average, each parent responded to 5.6 ( $SD = 1.4$ ) of seven daily surveys. Mean correlations between mealtime routines were small ( $r$ s between  $-0.14$  and  $0.25$ ), suggesting independent and distinct routines. Creating a positive atmosphere and turning TV and smartphones off were reported most often (on average, 91.2% and 90.5%, respectively). Parent’s fruit and vegetable intake and creating a positive mealtime atmosphere were the strongest predictors for children’s higher nutritional quality (i.e., higher vegetable and fruit intake;  $p$ s  $< .001$ ). Findings indicate that mealtime routines obtained from independent meta-analyses represent distinct routines. Families practiced these independent and distinct routines to different degrees. Parental modeling and a positive mealtime atmosphere were most predictive of healthier child nutrition in daily family meal settings. More experimental research is needed to better understand causality and provide a better basis for effective interventions.

---

## 1. Introduction

Eating is an essential social experience. Most shared meals are consumed in a family context (Frank et al., 2019) and theoretical frameworks emphasize the importance of family systems for health promotion (see Michaelson et al., 2021, for an overview). According to these frameworks, the creation of a healthy environment—including the structuring of family meals, parents acting as nutritional gatekeepers, and parental modeling behavior—is essential for behavior change (e.g., Golan & Weizman, 2001). Extending ecological models, Davison et al. (2013) included the child and their behavior and cognition as an actor contributing to the interdependent system *family*.

There has been disagreement in the scientific literature about what exactly constitutes a family meal (see, e.g., Martin-Biggers et al., 2014, for an overview). Some studies proposed that the entire family has to sit at the table to maximize the positive aspects of eating together (e.g., Ørverby et al., 2020), whereas others used a less strict definition (e.g., Robson et al., 2020). Importantly, the meta-analysis by Dallacker et al. (2018) did not find an effect of the number of family members at the table on the relation between family meal frequency and children’s nutritional health. As a practical consequence, meals with as few as two people eating together can count as family meals.

Over the past 20 years, numerous studies have consistently shown that more frequent family meals are associated with several positive outcomes regarding children’s nutritional health, including higher fruit and vegetable intake and overall healthy eating, lower soft drink consumption, lower body mass index (BMI), and fewer eating disorders (e.g., Dallacker et al., 2018; Glanz et al., 2021; Robson et al., 2020). Yet, the underlying mechanisms are still not well understood (Rosemond et al., 2019), despite promising findings from cross-sectional studies: A meta-analysis by Dallacker et al. (2018) identified six mealtime routines that are linked to healthier nutrition and body weight in children. These

routines include parental modeling, TV off during meals, meals prepared at home, children's involvement in preparation, longer meal duration, and positive mealtime atmosphere. A particular focus of our study was on the practice of these family mealtime routines in a large, heterogeneous sample of families living in Germany. We additionally investigated smartphone use because digital devices are increasingly replacing TV use (Breunig et al., 2020) and their use have been shown to potentially decrease family mealtime enjoyment (Dwyer et al., 2018).

## 1.1 Research gaps

### 1.1.1. Validation of the mealtime routines

Dallacker and colleagues' (2019) identification of six mealtime routines was the first systematic approach to summarizing frequently investigated mealtime routines. The routines were drawn from the literature without considering their prevalence. Therefore, Dallacker et al. could not determine the degree to which the routines were actually practiced and integrated into families' everyday life: Do families use one, several or all of these mealtime routines during a typical meal?

### 1.1.2. Relationship between family mealtime routines

Many studies examined the impact of individual family mealtime routines on various child health outcomes (e.g., fruit and vegetable intake, diet quality, BMI; for a meta-analysis see Dallacker et al., 2019). Only a handful of studies considered two different mealtime routines (e.g., Dwyer et al., 2018; Feunekes et al., 1995; Fulkerson et al., 2014; Trofholz et al., 2017). Since a complex social situation such as a family meal is likely not sufficiently described by one or two behavioral routines it means that our knowledge about this paradigmatic social institution family meal is severely limited. Also, investigating intercorrelations between routines addresses the extent to which they represent distinct or overlapping behaviors.

Studies that went beyond a single routine all turned to the relationship of media use and mealtime atmosphere. In summary, media consumption in general and mealtime atmosphere have been found to be negatively correlated. More specifically, TV consumption at family meals was negatively associated with mealtime atmosphere (Trofholz et al., 2017); restaurant meals with family and friends were less enjoyable and associated with a lower sense of well-being when smartphones lay on the table (Dwyer et al., 2018), and general media use was related to lower quality of family communication (Fulkerson et al., 2014). In contrast, link between mealtime atmosphere and the meal's duration has received scant attention: One diary study showed that the duration of a face-to-face social interaction predicted participants' happiness (Vlahovic et al., 2012), and there are indications that this finding generalizes to the duration of social interaction at family meals and positive atmosphere (Feunekes et al., 1995).

### 1.1.3. Family mealtime routines and Children's diet quality

Most studies that examined the impact of family mealtime routines on children's nutritional health outcomes are cross-sectional. The few longitudinal studies concentrated on ensuring temporal order of effects by using a panel design and collecting data at two measurement times, years apart. For example, Larson et al. (2007) showed that more frequent family meals in adolescence was associated with more fruit and vegetable intake and less soft drink consumption about 5 years later, in early adulthood. Metcalfe and Fiese (2018) reported higher fruit and vegetable intake among preschoolers after more involvement in food preparation 1 year earlier. To better understand consecutive day-to-day family mealtime routines, daily measurement designs are desirable. For example, Berge et al. (2014) evaluated video-recorded family meals over 8 consecutive days and found associations between positive family dynamics (i.e., warmth, group enjoyment, parental positive reinforcement) at family meals and reduced risk of being overweight in childhood.

### 1.1.4. Experimental manipulation of mealtime atmosphere

Research on causal relations between family mealtime routines and children's diet quality is very rare. One of the few exceptions studied whether experimentally induced noise caused distraction during the mealtime (Fiese et al., 2015). Indeed, the noise led to less positive communication between family members and children ate more cookies. Another recent experiment invited parent-child dyads twice to the lab and served a typical German evening meal (consisting of bread, cold cuts, cheese, fruits, and vegetables, etc.). In one condition, the dyads had as much time for their dinner as they usually take; in the other condition they had 50% more time. Longer meal duration increased children's consumption of fruits and vegetables but did not significantly increase their consumption of bread and cold cuts (Dallacker et al., 2017). Building on this study, we chose mealtime atmosphere—the second largest predictor next to duration—as a target routine for another first intervention attempt (cf. Dallacker et al., 2019).

## 1.2 Hypotheses and research questions

Our first goal was to describe the extent to which family mealtime routines are actually practiced: We expected (1) the seven target routines reported previously to also manifest in the everyday context of family meals. Although one can expect the seven target routines to play some role in family meal contexts, little is known about their prevalence and concurrence. Our second goal was to examine the interrelations between those seven mealtime routines. Based on the limited past evidence, we predicted (2a) a negative link between media consumption (TV and smartphone) during the meal and mealtime atmosphere and (2b) a positive link between mealtime duration and atmosphere during the meal. Furthermore, by their nature, home-made and freshly prepared foods, unlike pre-fabricated food, permit but do not necessitate parents to involve their children in the preparation of meals. We predicted (2c) that children's involvement in meal preparation is positively related to a home-prepared meal. Given the general scarcity of theoretical models and empirical studies on the relation between different mealtime routines, our examination of the other links between the seven different family mealtime routines was inevitably exploratory.

Our third goal was to investigate the influence of the seven mealtime routines on diet quality. We did so in two different ways: First, we compared the relative influence of the routines within the same statistical model. Second, we implemented an intervention for mealtime atmosphere, and predicted a different influence on nutritional quality for different experimental groups. On the basis of the meta-analysis by Dallacker et al. (2019), we predicted (3) a small effect of all routines on children's fruit and vegetable intake.

## 2. Methods

### 2.1. Transparency and openness

We report all data exclusions, all manipulations, and all measures that were included in the study. In addition, all data, analysis code, and research materials are available at [https://osf.io/c9y3t/?view\\_only=cf732061e0084486be698adea8b1540a](https://osf.io/c9y3t/?view_only=cf732061e0084486be698adea8b1540a). Data were analyzed using RStudio version 1.3.959 (RStudioTeam, 2020). The ethics commission of the University of Mannheim approved this study.

### 2.2. Design and procedure

Adult participants were recruited via telephone from forsa.omninet panel, an internet panel that is representative of the German population aged 14 and over. To be eligible, participants needed to have at least one child between 3 and 17 years old. Only one parent per family participated in the study. This parent was instructed to answer the questionnaire in relation to themselves and to one child of the family. If there was more than one child in the family, the parent was asked to answer with

respect to the child with the most recent birthday (the 'index child'). After giving informed consent, participants answered an entry questionnaire and then were randomly assigned to one of three experimental groups (see details below). Over the next 7 consecutive days all participants answered identical questions about their mealtime routines every day between 6 p.m. and midnight. Participants could receive a maximum reward of €10 for taking part in the study: €1.50 for answering the first questionnaire and another €1 for each additional questionnaire answered, and if they answered all seven questionnaires, a bonus of €2.50.

### 2.3. Measures

#### 2.3.1. Entry questionnaire

Participants reported the number of adults and children living in their household and were asked the following about the index child: age, gender, height, and weight, as well as daily portions of fruits and vegetables eaten during a usual week. Additionally, parents reported their own age, gender, relationship and employment status, educational qualifications, and household income after taxes. Parents also reported which family member was mainly responsible for meal planning/preparation and had the strongest influence on the nutrition of the family (answer options: myself, my partner, both, others).

#### 2.3.2. Daily questionnaires

**Meal Characteristics.** Family meals are here defined as meals in which at least one parent eats breakfast, lunch, dinner, or any other meal together with at least one child (i.e., the index child). We thus took the substantial number of single-parent or working-parent households into account (Middleton et al., 2020). This definition is in line with theoretical frameworks focusing on what families *do* (e.g., how they eat) rather than how they *look* (e.g., their socioeconomic status). First, parents described the characteristics of the meal as follows: most important family meal of the day (answer options: breakfast, lunch, dinner, other meals, and no meal), meal participants (e.g., mother, father, others), location (e.g., at home, restaurant, other); and whether their child had eaten the same or a different dish from the adults (5-point scale of 1 = *ate something completely different* to 5 = *ate the same dish as the adults*). If they reported not having had a family meal, they received no further questions that day.

**Mealtime Routines.** Participants reported on different routines of their most important family meal of the day (based on the meta-analysis by Dallacker et al., 2019). Media consumption during the meal was assessed by asking participants if the TV was on during the meal (5-point Likert scale of 1 = *yes, all the time* to 5 = *no, at no time*; adapted from Horodyski et al., 2010). Equivalent questions were asked for smartphone use. Atmosphere during the meal was measured with four items (Cronbach's  $\alpha = 0.82$ ), asking about perceived mealtime atmosphere, parent's satisfaction with the meal, enjoyment of the meal, and child's mood during the meal on a 5-point Likert scale (1 = *very negative* to 5 = *very positive* or 1 = *not at all* to 5 = *much enjoyed/very satisfied*). Parental modeling was assessed in two ways: (1) Participants were asked if they had deliberately eaten fruit or vegetables during the meal to be a role model for their child (5-point Likert scale from 1 = *not at all* to 5 = *very much*, adapted from Musher-Eizenman & Holub, 2007); (2) they reported their own fruit and vegetable intake during the meal (from "0" to "4.5 or more portions" in steps of 0.5 portions; adapted from Harris & Ramsey, 2015). Involvement was measured by asking how the index child had helped or was involved in preparing the meal (5-point Likert scale from 1 = *did not help/was not involved at all* to 5 = *helped a lot/was very involved*; adapted from Chu et al., 2013); this question was only asked if the most important meal was eaten at home or a friend's/relative's house. Duration of a meal was self-measured and then reported in minutes (open answer). Quality of a meal was assessed by asking if the food was homemade (yes/no; adapted from Sweetman et al., 2011).

**Fruit and Vegetable Intake.** Parents were asked about the index child's fruit and vegetable intake during the meal (from "0" to "4.5 or more portions" in steps of 0.5 portions; adapted from Harris & Ramsey, 2015).

**Control Variables.** Parents reported whether and how many different types of fruit and vegetables were offered at the meal. Additionally, parents in the intervention and the active control group reported the extent to which they had focused their conversation exclusively on positive topics or had conversations about a random topic (5-point Likert scale from 1 = *not at all* to 5 = *very much*).

#### 2.3.3. Final questionnaire

At the end of study, participants rated how typical the study week was regarding their child's eating behavior (6-point Likert scale from 1 = *very untypical* to 6 = *very typical*) and their own height and weight.

### 2.4. Experimental manipulation

We experimentally manipulated mealtime atmosphere by providing instructions that outline desired behaviors. Parents in the passive control group answered the daily questionnaires without further instructions. Parents in the active control group were additionally instructed to choose at least one topic of their liking to talk about during mealtime. Parents in the intervention group were instructed to strive to create a positive atmosphere during mealtime by talking about positive topics and by avoiding disciplining children during mealtime. Experimental group and the active control group received their instruction after finishing the entry questionnaire and obtained a reminder every study day as part of the invitation for the daily questionnaire.

### 2.5. Participants

A total of 351 parents took part in the study; 41 parents who completed fewer than two questionnaires over the study week were excluded. The final sample comprised 310 participants. Parents ranged in age from 18 to 76 ( $M = 41.6$ ,  $SD = 7.0$ ) and children from 3 to 17 years ( $M = 8.9$ ,  $SD = 4.18$ ). Gender distribution was similar for children and parents such that about half were girls/mothers. Of all parents, 58% reported not having a university degree. The BMI for parents and children ranged widely: children's z-BMI from -5.46 to 3.44 and parents' BMI from 17.26 to 48.44 (for detailed sample characteristics see Table 1).

### 2.6. Statistical analyses

When information on parents' or children's fruit and vegetable intake were missing, we assumed zero servings of fruit and vegetables for that day. To examine the frequency of mealtime practices, we first calculated frequency tables to analyze, which mealtime routines families put into practice. Next, we ran multilevel intercept-only models (with family on Level 2 and days on Level 1) to test within and between variance for all mealtime routines. To examine Hypothesis 2, we calculated correlations, separately for each of the consecutive 7 study days. Hypothesis 3 was tested using random-intercept models with children's fruit and vegetable intake during the meal as independent, and family mealtime routines as dependent variables; control variables were number of offered fruit and vegetable portions, weekend versus weekday, and intervention-group membership. As an additional test of Hypothesis 3, especially addressing mealtime atmosphere, we implemented two multilevel models with intervention group as the predictor and both, mealtime atmosphere and fruit and vegetable intake, as dependent variables. This allowed us to examine whether the experimental manipulation of mealtime atmosphere increased children's fruit and vegetable intake. Analyses were conducted using RStudio's lmerTest package for mixed models (Kuznetsova et al., 2020) and ggplot2 for figures (Wickham et al., 2021). Hypotheses were specified before data

**Table 1**  
Sample characteristics.

Variable	Parent		Child	
	M	SD	M	SD
Answered daily questionnaires	5.76	1.34		
Age (in years)	41.61	7.00	8.93	4.18
BMI (kg/m <sup>2</sup> )				
Female	25.28	4.98	-0.40 <sup>a</sup>	
Male	26.51	3.57	-0.49 <sup>a</sup>	
	<i>n</i>	%	<i>n</i>	%
Sex				
Female	167	53.87	162	52.25
Education				
Secondary	92	29.67		
Higher level/qualification for university entrance	69	22.26		
University	132	42.58		
Other	16	5.16		
Nutritional gatekeeper				
Me	140	45.16		
Partner	63	20.32		
Both	105	33.87		
Other	2	0.65		
Monthly household income				
Under 2000 euros	29	9.35		
2000–2999 euros	57	18.39		
3000 euros and more	187	60.32		

Note. *N* = 310. Participants who did not provide information are not included in the table; therefore, 100 – shown percentage values = percentage of missing responses.

<sup>a</sup> Body mass index (BMI) z scores, which indicate standard deviation from the mean of the population (age-adjusted and calculated based on The Child and Adolescent Health Survey reference data for 2003 to 2006; Neuhauser et al., 2013); 75% of children in this sample were healthy weight, 11% overweight, and 14% underweight.

**Table 2**  
Mealtime characteristics and routines (mean value per family, averaged across all families).

		M	SD	%
Meal type	Breakfast			13.31
	Lunch			24.39
	Dinner			56.79
	Other			0.70
Others present at the meal	None			4.81
	Mother			91.34
	Father			74.13
Location	Other			18.00
	At home			89.97
	Restaurant			3.11
Same food as adults	Other			6.92
				75.03
Mealtime routines	Homemade (yes/no)			86.91
	Duration (min)	29.39	10.65	
	Atmosphere <sup>a</sup>	4.05	0.41	
	Involvement <sup>a</sup>	1.93	0.71	
	Modeling			
	Deliberately <sup>a</sup>	2.49	1.03	
	Fruit and vegetable intake <sup>b</sup>	1.10	0.76	
	TV use <sup>a</sup>	0.31	0.72	
	Smartphone use (from 1 to 5)	0.11	0.24	
	Child's nutritional health	Fruit and vegetable intake <sup>b</sup>	0.95	0.66

Note. Meal characteristics calculated for each family as frequency of characteristic divided by number of total answers for this item and then averaged over families. Means and standard deviations calculated for each family over the week and then averaged across families.

<sup>a</sup> Rated on a scale of 1–5.

<sup>b</sup> Number of fruit and vegetable portions.

collection and also the analytic plan was pre-specified.

### 3. Results

#### 3.1. Descriptive statistics

Parents rated their child's eating behavior during the study week as "rather typical" ( $M = 4.98$ ,  $SD = 0.80$  on a 6-point scale). On average, families described dinner as the most important family meal. The family meals usually took place at home (see Table 2 for details).

#### 3.2. Frequency of mealtime routines

For each family, we calculated the percentage of days on which they reported using a specific routine during their meals, and then calculated the average (percentage) use across all families. Fig. 1 shows that parents reported a positive atmosphere for most of the meals. In addition, TV and smartphones were off during almost all meals, and the vast majority of meals were prepared at home. For about half of the meals, both parents deliberately modeled behavior, and children were involved in the preparation. Nearly 1 of 4 meals had a considerably longer duration (i.e., at least 10% longer than the mode; 33 min in this sample). In addition, we also examined the number of routines used in a family meal: On average, a family uses more than four different routines per meal ( $M = 4.62$ ,  $SD = .78$ ). Some family mealtime routines occur particularly often together (see contingency table in the supplemental materials), for example positive atmosphere and smartphone off. Thus, according to self-report data, the seven target family meal routines, drawn from the literature, do occur in families' lives, even though their frequencies differ substantially. Frequency data are comparable across all three study groups, with small differences in meal atmosphere and children's involvement (see supplementary material for routine use by intervention group).

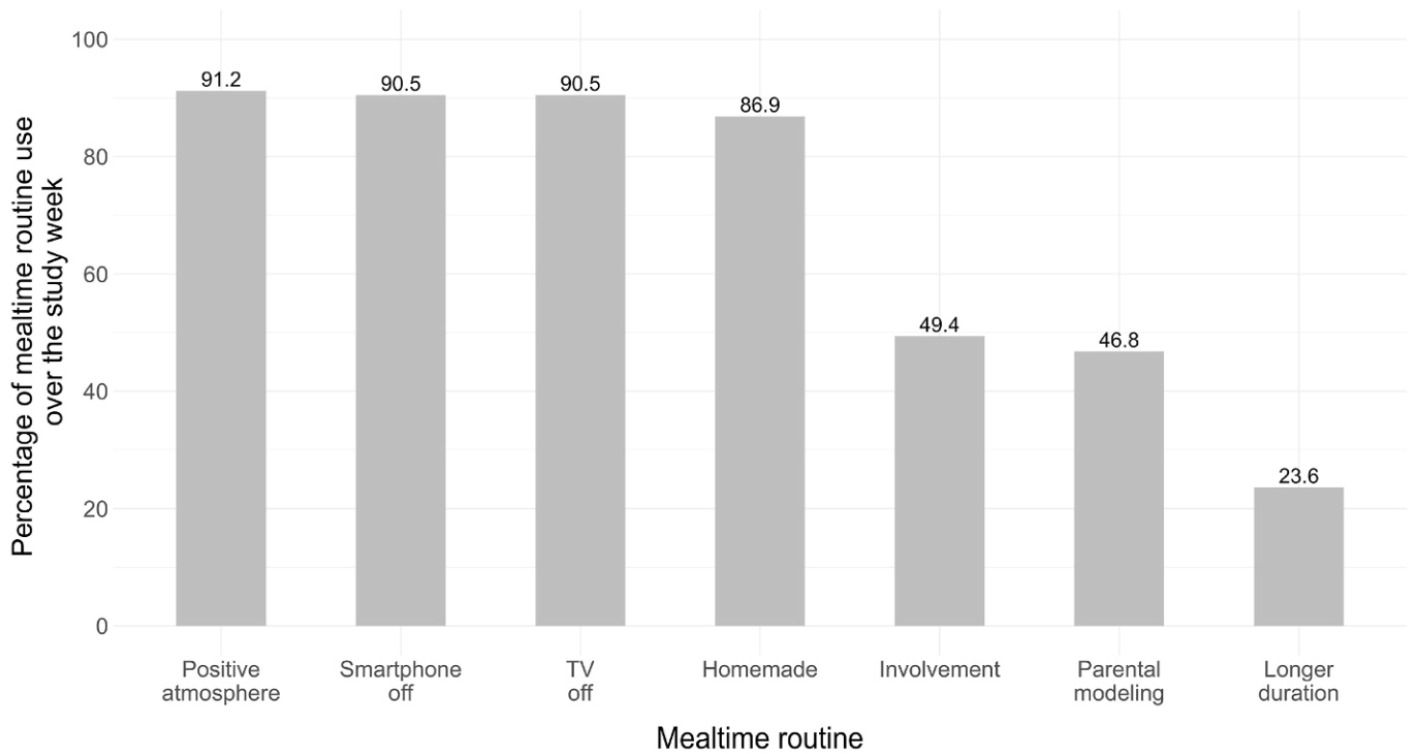
Next, we calculated how the different routines varied within one family over 7 days versus between families using multilevel intercept- only models (see Fig. 2). All routines except parental modeling varied more within families than between families (within-family variance: 42.8%–95.5%; between-families variance: 4.5%–57.2%). To account for this large share of within-family variance, we use multilevel modeling in the following analyses.

#### 3.3. Relation between mealtime routines

Table 3 shows the mean correlation between routines, averaged over all study days, as well as the respective minimum and maximum correlations (i.e., the highest and the lowest correlation on any of the study days). The highest mean correlation was observed between mealtime duration and atmosphere ( $r = 0.25$ ), followed by mealtime atmosphere and child's involvement in meal preparation ( $r = 0.15$ ). In general, the associations between different meal routines are rather small and even though they show a notable variability between the individual study days, the variability in correlations for weekdays versus weekends was very small (see supplementary material for individual correlation tables; to exclude bias due to experimental manipulation, graphs and tables for frequency and relations are also provided separately for the three groups in the Supplementary Materials. All results with the passive control group only are comparable in effect size and direction.).

#### 3.4. Prediction of Children's fruit and vegetable intake

To test whether family mealtime routines predict children's fruit and vegetable intake, a random intercept model was specified. Fruit and vegetable intake (i.e., the sum of eaten portions of fruits and vegetables during the meal) was used as the dependent variable. Predictors were atmosphere, involvement, duration, modeling (deliberate modeling as well as the sum of parent's fruit and vegetable intake), homemade, TV



**Fig. 1.** Percentage of use of seven family mealtime routines averaged across all families.

*Note.* The percentage of use was calculated as frequency of routine use divided by number of total answers for an item (e.g., 7 = item was answered on all 7 days of the study). Smartphone off and TV off = All meals for which “never” (i.e., never on) was the chosen answer category; homemade = all meals where the answer to the item was “yes” (i.e., homemade); positive atmosphere = all meals with an item score >3; longer duration = all meals that took at least 10% longer than the mode (33 min in this sample); involvement = all meals for which the answer was at least “a little involved”; parental modeling = all meals for which the item assessing if fruits and vegetables were eaten deliberately was answered with at least “somewhat true.”

and smartphone. Further, we controlled for the sum of offered portions of fruits and vegetables, weekday versus weekend, and intervention group membership. The results show a significant predictive effect of the implicit measure of parental modeling—parental fruit and vegetable intake ( $p < .001$ ,  $R^2 = 0.52$ )—and positive mealtime atmosphere ( $p < .001$ ,  $R^2 = 0.10$ ) on fruit and vegetable intake of children (see Table 4). The coefficients remain largely unchanged in size, direction, and statistical significance when further controlling for children’s age, gender, and BMI z score, or parent’s educational level, household income, and being the nutritional gatekeeper.

### 3.5. Manipulation of mealtime atmosphere

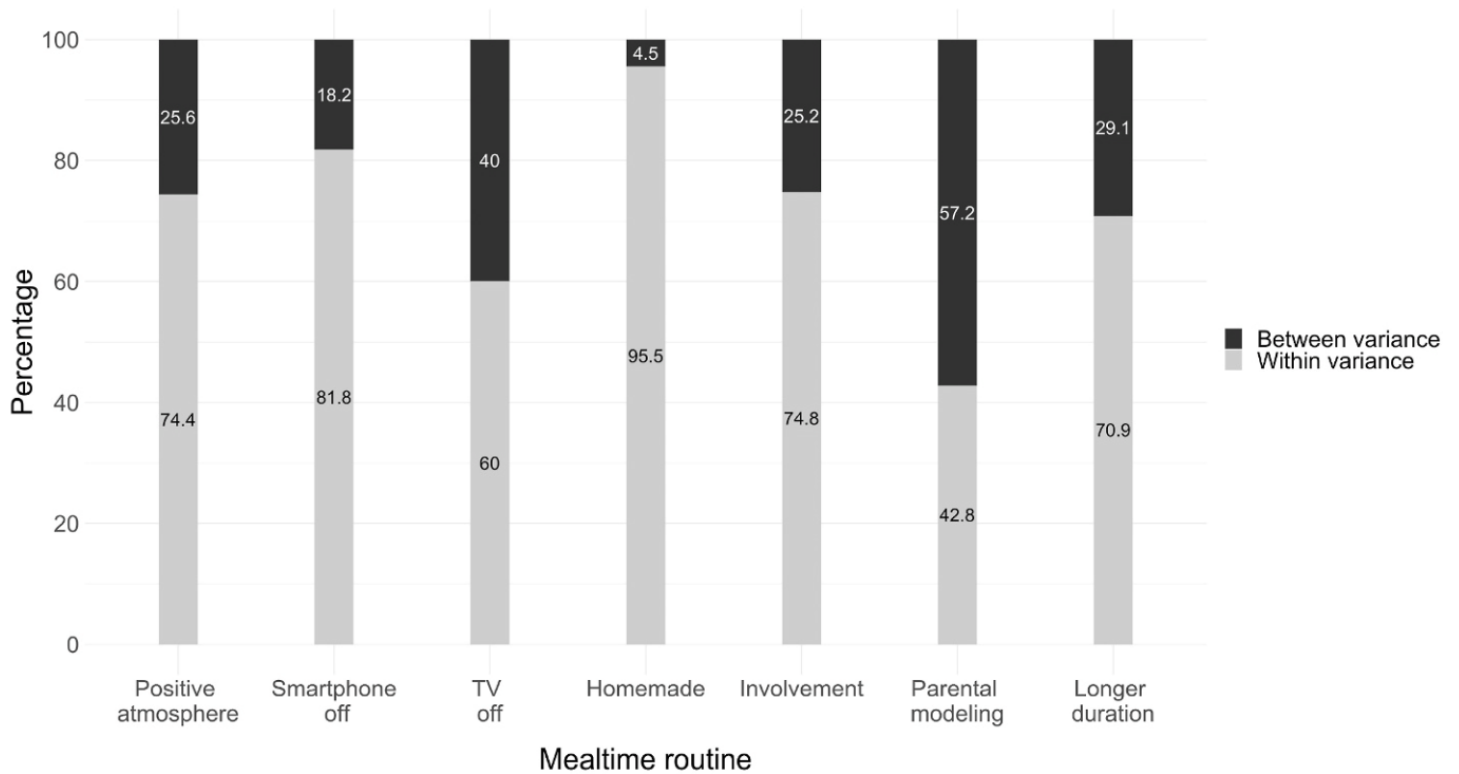
Families in the active control group stated that, on average, in 76% of their meals they were able to implement the task of discussing a topic well or very well. Families in the intervention group were able to address only positive topics and avoid disciplining children well or very well in, on average, 65% of their meals. To analyze the effect of the mealtime atmosphere interventions, we computed a multilevel model. Group membership was dummy coded (with the intervention group as the baseline condition) and included in the model as a predictor, and atmosphere was the dependent variable. Results show no significant differences in atmosphere between the control groups and the intervention group. In addition, there was also no significant group difference in the children’s fruit and vegetable intake (for a regression table see supplementary materials). We therefore refrained from testing a mediation model with group as predictor, fruit and vegetable intake as outcome, and mealtime atmosphere as mediator.

## 4. Discussion

Evidence-based family mealtime routines are regularly practiced in everyday family meal situations. The routines prove relatively distinct from each other. Some but not all the routines predict children’s fruit and vegetable intake during family meals when compared to each other within the same model. The current work extends previous cross-sectional research on individual family mealtime routines with a daily assessment field study. Going beyond past research’s narrow focus on one or two routines, the present study analyzed a total of seven routines.

All mealtime routines were reported to be practiced, even though frequency differed substantially. Specifically, we found that in contrast to media reports, the consumption of TV and smartphone use played a very small role at the family meal table, with reported use below 10%. Similarly, mealtime atmosphere was rather positive to very positive in over 90% of the meals per family. In addition, 87% meals were reported to be homemade. In contrast, children’s involvement in meal preparation and parental modeling occurred, on average, considerably less frequently in about 50% of meals. Longer duration of a meal occurred in only about 25% of reported meals. Importantly, the average family used more than 4 mealtime routines per meal, which underlines the importance of studying different routines simultaneously. Overall, the use of routines is the rule rather than the exception. Importantly, these patterns of use emerged consistently across the three experimental groups.

Conducting the study across 7 consecutive days allowed us to examine the day-to-day differences in the practice of the different mealtime routines. Except for parental modeling, all routines showed much larger variability within than between families. This means that many differences in family meals will likely not be detected between families but rather within families over the course of a typical week. This



**Fig. 2.** Percentage of Within-Family and Between-Families Variance for All Seven Mealtimes Routines

*Note.* Smartphone off and TV off = All meals for which “never” (i.e., never on) was the chosen answer category; homemade = all meals where the answer to the item was “yes” (i.e., homemade); positive atmosphere = all meals with an item score >3; longer duration = all meals that took at least 10% longer than the mode (33 min in this sample); involvement = all meals for which the answer was at least “a little involved”; parental modeling = all meals for which the item assessing if fruits and vegetables were eaten deliberately was answered with at least “somewhat true.”

**Table 3**  
Correlations between mealtimes routines averaged over all 7 study days.

Variable	1	2	3	4	5	6	7	8
1. TV								
2. Smartphone	.02 [-.04, .11]							
3. Atmosphere	-.05 [-.14, .05]	.03 [-.04, .08]						
4. Involvement	-.06 [-.18, .05]	.03 [-.02, .06]	.15 <sup>+</sup> [.00, .21]					
5. Duration	-.05 [-.10, .00]	.07 [-.04, .22]	.25* [.19, .33]	.10 [.04, .21]				
6. Quality	-.03 [-.12, .05]	-.08 [-.18, .03]	.02 [-.09, .16]	.09 [-.07, .17]	-.14 <sup>+</sup> [-.27, -.06]			
7. Deliberate parental modeling	-.05 [-.08, .07]	-.06 [-.14, .00]	.03 [-.04, .12]	.13 [-.07, .23]	-.03 [-.21, .10]	.05 [-.06, .19]		
8. Veg and fruit parent	-.04 [-.13, .04]	-.06 [-.13, .01]	.18 [.10, .25]	.09 [.02, .18]	.17 [.05, .32]	.14 [-.01, .24]	.13 [.00, .27]	
9. Veg and fruit child	-.04 [-.10, .01]	-.04 [-.18, .08]	.20 <sup>+</sup> [.10, .25]	.12 [.03, .26]	.16 <sup>+</sup> [.07, .28]	.13 [-.03, .23]	.06 [-.14, .20]	.79* [.72, .85]

*Note.* Values in square brackets represent minimum and maximum correlations during the 7-day study period. Veg and fruit = Vegetable and fruit intake during the meal. \* $p < .05$  on all 7 study days. <sup>+</sup> $p < .05$  on 4 or more study days.

underlines the value designs with consecutive data collection in this research.

Another goal was to understand whether the family mealtimes routines identified to date represent distinct or overlapping behaviors. The small correlations between the seven routines suggest that their distinct nature. In contrast to Hypothesis 2a and previous research (Trofholz et al., 2017), we found only minimal correlations between mealtimes atmosphere and media consumption. The correlation between atmosphere and TV consumption across all survey days was very small but in the expected negative direction; the correlations with smartphone consumption were near zero. One likely explanation for these findings could be the little variance regarding norms and behaviors pertaining to media use at the meal table in our sample: In over 90% of the reported meals, TVs and smartphones were turned off. There are likely to be notable cultural differences. Even though family culture in Germany seem to mostly ban the use of media during meals, having the TV turned on during meals is very common in other European countries such as Greece and Portugal (Roos et al., 2014). Further, self-report of media use

**Table 4**  
Prediction of Child's fruit and vegetable intake through mealtime routines.

Effect	Estimate	SE	95% CI		p
			LL	UL	
<b>Fixed effects</b>					
Intercept	.11	.10	-.08	.31	.248
Duration	-.01	.03	-.06	.05	.787
Involvement	.04	.02	-.01	.08	.101
Atmosphere	.10	.02	.05	.14	<.001
Veg and fruit intake parent	.52	.03	.47	.58	<.001
Deliberate parental modeling	-.03	.02	-.08	.01	.156
Quality	.05	.09	-.13	.22	.593
Smartphone	-.02	.02	-.06	.03	.425
TV	-.01	.02	-.06	.04	.630
Offered	.22	.03	.16	.28	<.001
Intervention group	-.04	.07	-.18	.09	.526
Active control group	.04	.07	-.10	.17	.602
Weekend	-.02	.04	-.11	.07	.655
<b>Random effects</b>					
Within-family variance	.39	.62			
Between-family variance	.12	.34			

*Note.* Total  $N = 305$ . All continuous variables were scaled by dividing the centered columns by their standard deviation to allow comparison of coefficients. Group is dummy-coded with the passive control group as the baseline condition. Veg and fruit = Number of consumed portions of fruits and vegetables during the meal; offered = number of different types of fruit and vegetables offered; CI = confidence interval; *LL* = lower limit; *UL* = upper limit. Conditional  $R^2 = 0.552$ .

and atmosphere could be biased by social desirability. Understanding when and why media use is negatively related to mealtime atmosphere would be an important next step.

Supporting Hypothesis 2b, we found the largest correlations between family mealtime routines for atmosphere and duration, corroborating past preliminary research (Feunekes et al., 1995; Vlahovic et al., 2012). Surprisingly and contrary to Hypothesis 2c, we found a very small relation between children's involvement in meal preparation and the meal being prepared at home. One may expect that the involvement of children in the preparation of dinner would be higher if the meal was homemade. A possible explanation could again be the small variance in meal preparation: Nearly all meals were prepared at home.

Two exploratory observations seem noteworthy: First, we found a comparably large correlation between meal atmosphere and the child's involvement in meal preparation. This is interesting, because involving children more in meal preparation could not only have direct effects on child nutrition, but also indirect beneficial effects via the fostering of the mealtime atmosphere. A lighter atmosphere may make family meals more enjoyable and thereby increase their frequency. Frequency of family meals and positive mealtime atmosphere, in turn, are related to better nutritional health in children (Dallacker et al., 2018). Second, even though medium to high correlations were observed between parents' and children's fruit and vegetable intake, the relation between deliberate parental modeling and the child's fruit and vegetable intake was small. A similar pattern emerges for Hypothesis 3: We found a notable, significant effect of parental modeling predicting children's fruit and vegetable intake only when operationalized as actual parental fruit and vegetable intake, not as deliberately performed modeling. This is relevant as the differentiation between actual behavior and deliberate modeling has not been considered in previous studies (see, e.g., Dallacker et al., 2019, for a meta-analysis).

Consistent with previous research and partially supporting Hypothesis 3, a more positive meal atmosphere predicted higher fruit and vegetable intake across the three experimental groups and independent of the experimental manipulation of atmosphere. Despite its predictive power in family meals, we still know little about what exactly constitutes a positive atmosphere. Does a positive atmosphere mean that everyone at the table is happy; that conversations are interesting, or that the food tastes good? A number of observational and self-report instruments differentiate aspects of mealtime atmosphere, such as emotional atmosphere, meal enjoyment, or positive social communication (Skafida, 2013; Trofholz et al., 2017). Our modest understanding of "positive atmosphere" might explain the failure in manipulating family atmosphere. For example, the active control group, instructed to talk about any topic, reported a more positive atmosphere than the intervention group, instructed to converse about positive things only. This finding might indicate that talking about something is better than not talking at all, or that families are naturally inclined or have learnt to raise enjoyable topics during family meals. It is also conceivable that an honest exchange about more serious topics can have a positive effect on the atmosphere at mealtimes if they have been discussed together as a family.

In contrast to Hypothesis 3 and the findings in Dallacker et al.'s (2019) meta-analysis, none of the other mealtime routines were predictive of children's fruit and vegetable intake during meals. We can think of several reasons for this lack of association. First, by covering a longer period, this study's setting differs from that of previous studies. Further, this is the first study to test all routines together in a single model, and, therefore, the influence of one mealtime routine is being controlled for all other routines. Third, more research across different settings and with potentially more fine-grained operationalizations of routines could further improve our understanding about what makes family meals healthy.

#### 4.1. Limitations, strengths, and future research

Major strengths of this study are its large, diverse sample and the daily assessment design on up to 7 consecutive days. This study is a self-report online survey and relies on participants' recall of family meals and routines. While this ensures information about everyday family meal settings without potentially obtrusive observers or technology, self-reports can be subject to social desirability or perception bias. This might be especially the case for topics such as a positive meal atmosphere, for which our data suggest a positive ceiling effect. This should be considered when interpreting the results. The diary design, however, can help reduce recall biases, as the time between meal and survey is relatively short. This method complements and extends findings from previous studies that were based on cross-sectional questionnaires or one-time observations of families in the laboratory or their home.

We are not aware of external criteria for what constitutes a "long" meal duration, and therefore we evaluated the duration of meals with respect to the data in our current sample. While this is a sensible approach given the high variability within and between families, additionally asking participants for a subjective rating of mealtime duration (e.g., whether a meal was shorter or longer than usual) might be a helpful indicator for mealtime duration in future studies.

One limitation is that the children's point of view was not assessed in this study. Rather, their parents answered items on behalf of the children (e.g., about fruit and vegetable consumption, the mood at the table, or the use of media). Importantly, given the large age range of children participating in this study (3–17 years) this was the most reliable and coherent way to obtain data on children's behavior in the current study setting.

Our diary study focused on the mealtime routines obtained as predictors for nutritional health that Dallacker et al. (2019) obtained. We extended TV use during mealtimes by adding smartphone use. In future research it would be interesting to extend the list of routines. Candidates include the availability and frequency of fruit and vegetable portions at the family meal. While this variable was treated as a control variable in the current study, understanding what predicts the number of portions offered as well as also including other indicators of healthy nutrition could further advance this field of research.

Generally, experimental research and randomized control trials are needed to better understand the causal relations between family mealtime routines and characteristics and the nutritional health of the family



members. One notable exception is the experiment by Fiese et al. (2015), finding detrimental effects of auditory noise (which could be one aspect of mealtime atmosphere) on children's nutrition.

## 5. Conclusion

Our goal was to contribute to a better understanding of the prevalence of family mealtime routines and their effects on healthy nutritional behaviors. We find them to be practiced in daily family meals, they represent distinct behaviors, and they partly predict children's nutritional health in the context of actual families. The research on the important social institution family meal is, however, still nascent. Much more needs to be done to better understand the routines by analyzing their individual components, to find causal evidence of their predictive power toward nutritional health using randomized control trials, and to refine theoretical frameworks of family systems for health promotion. The efforts promise high returns as family meals, as the cradle of eating behavior, are a promising and low-threshold intervention approach to improve children's nutrition and overall health.

## Author contributions

Vanessa Knobl Conceptualization Formal analysis Visualization Writing: Original draft Mattea Dallacker Conceptualization Methodology Writing: Review and Editing Ralph Hertwig Conceptualization Writing: Review and Editing Jutta Mata Conceptualization Funding acquisition Methodology Project Administration Supervision Writing: Review and Editing.

## Funding

This study was financially supported by an internal fund of the University of Mannheim.

## Ethical statement

Hereby, I, Vanessa Knobl, consciously assure that for the manuscript 'Happy and healthy: How family mealtime routines relate to child nutritional health' the following is fulfilled:

- 1) This material is the authors' own original work, which has not been previously published elsewhere.
- 2) The paper is not currently being considered for publication elsewhere.
- 3) The paper reflects the authors' own research and analysis in a truthful and complete manner.
- 4) The paper properly credits the meaningful contributions of co- authors and co-researchers.
- 5) The results are appropriately placed in the context of prior and existing research.
- 6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference.
- 7) All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content.
- 8) This study was approved by ethics commission of the University of Mannheim.

## Declaration of competing interest

None.

## Acknowledgements

We are grateful to Anita Todd for editing this manuscript.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://hdl.handle.net/21.11116/0000-0009-D1B4-F>.

## References

- Berge, J. M., Rowley, S., Trofholz, A., Hanson, C., Rueter, M., MacLehose, R. F., & Neumark-Sztainer, D. (2014). Childhood obesity and interpersonal dynamics during family meals. *Pediatrics*, 134(5), 923–932. <https://doi.org/10.1542/peds.2014-1936>
- Breunig, V. C., Handel, M., & Kessler, B. (2020). *Massenkommunikation 1964–2020: Mediennutzung im Langzeitvergleich* (Vols. 7–8) pp. 410–432. Media Perspektiven.
- Chu, Y. L., Farmer, A., Fung, C., Kuhle, S., Storey, K. E., & Veuglers, P. J. (2013). Involvement in home meal preparation is associated with food preference and self-efficacy among Canadian children. *Public Health Nutrition*, 16(1), 108–112. <https://doi.org/10.1017/S1368980012001218>
- Dallacker, M., Hertwig, R., & Mata, J. (2018). The frequency of family meals and nutritional health in children: A meta-analysis: Family meals and children's health. *Obesity Reviews*, 19(5), 638–653. <https://doi.org/10.1111/obr.12659>
- Dallacker, M., Hertwig, R., & Mata, J. (2019). Quality matters: A meta-analysis on components of healthy family meals. *Health Psychology*, 38(12), 1137–1149. <https://doi.org/10.1037/hea0000801>
- Dallacker, M., Mata, J., & Hertwig, R. (2017). *Longer meal duration increases healthy eating in children. An experimental study*. Padua: EHPS.
- Davison, K. K., Jurkowski, J. M., & Lawson, H. A. (2013). Reframing family-centred obesity prevention using the Family Ecological Model. *Public Health Nutrition*, 16 (10), 1861–1869. <https://doi.org/10.1017/S1368980012004533>
- Dwyer, R. J., Kushlev, K., & Dunn, E. W. (2018). Smartphone use undermines enjoyment of face-to-face social interactions. *Journal of Experimental Social Psychology*, 78, 233–239. <https://doi.org/10.1016/j.jesp.2017.10.007>
- Feunekes, G. I. J., de Graaf, C., & van Staveren, W. A. (1995). Social facilitation of food intake is mediated by meal duration. *Physiology & Behavior*, 58(3), 551–558. [https://doi.org/10.1016/0031-9384\(95\)00087-Y](https://doi.org/10.1016/0031-9384(95)00087-Y)
- Fiese, B. H., Jones, B. L., & Jarick, J. M. (2015). Family mealtime dynamics and food consumption: An experimental approach to understanding distractions. *Couple and Family Psychology: Research and Practice*, 4(4), 199–211. <https://doi.org/10.1037/cfp0000047>
- Frank, M., Brettschneider, A.-K., Lage Barbosa, C., & Mensink, G. B. (2019). Prevalence and temporal trends of shared family meals in Germany. Results from EsKiMo II. *Ernahrungs Umschau*, 66(4), 60–67. <https://doi.org/10.4455/eu.2019.013>
- Fulkerson, J. A., Loth, K., Bruening, M., Berge, J., Eisenberg, M. E., & Neumark-Sztainer, D. (2014). Time 2 tlk 2nite: Use of electronic media by adolescents during family meals and associations with demographic characteristics, family characteristics, and foods served. *Journal of the Academy of Nutrition and Dietetics*, 114(7), 1053–1058. <https://doi.org/10.1016/j.jand.2013.10.015>
- Glanz, K., Metcalfe, J. J., Folta, S. C., Brown, A., & Fiese, B. (2021). Diet and health benefits associated with in-home eating and sharing meals at home: A systematic review. *International Journal of Environmental Research and Public Health*, 18(4). <https://doi.org/10.3390/ijerph18041577>. Article 1577.
- Golan, M., & Weizman, A. (2001). Familial approach to the treatment of childhood obesity: Conceptual model. *Journal of Nutrition Education*, 33(2), 102–107. [https://doi.org/10.1016/S1499-4046\(06\)60173-5](https://doi.org/10.1016/S1499-4046(06)60173-5)
- Harris, T. S., & Ramsey, M. (2015). Paternal modeling, household availability, and paternal intake as predictors of fruit, vegetable, and sweetened beverage consumption among African American children. *Appetite*, 85, 171–177. <https://doi.org/10.1016/j.appet.2014.11.008>
- Horodyski, M. A., Stommel, M., Brophy-Herb, H. E., & Weatherspoon, L. (2010). Mealtime television viewing and dietary quality in low-income African American and Caucasian mother-toddler dyads. *Maternal and Child Health Journal*, 14(4), 548–556. <https://doi.org/10.1007/s10995-009-0501-2>
- Kuznetsova, A., Brockhoff, P. B., Christensen, R. H. B., & Jensen, S. P. (2020). lmerTest: Tests in linear mixed effects models, 3.1-3 [Computer software] <https://CRAN.R-project.org/package=lmerTest>.
- Larson, N. I., Neumark-Sztainer, D., Hannan, P. J., & Story, M. (2007). Family meals during adolescence are associated with higher diet quality and healthful meal patterns during young adulthood. *Journal of the American Dietetic Association*, 107(9), 1502–1510. <https://doi.org/10.1016/j.jada.2007.06.012>
- Martin-Biggers, J., Spaccarotella, K., Berhaupt-Glickstein, A., Hongu, N., Worobey, J., & Byrd-Bredbenner, C. (2014). Come and get it! A discussion of family mealtime literature and factors affecting obesity risk. *Advances in Nutrition*, 5(3), 235–247. <https://doi.org/10.3945/an.113.005116>
- Metcalfe, J. J., & Fiese, B. H. (2018). Family food involvement is related to healthier dietary intake in preschool-aged children. *Appetite*, 126, 195–200. <https://doi.org/10.1016/j.appet.2018.03.021>
- Michaelson, V., Pilato, K. A., & Davison, C. M. (2021). Family as a health promotion setting: A scoping review of conceptual models of the health-promoting family. *PLoS ONE*, 16(4), Article e0249707. <https://doi.org/10.1371/journal.pone.0249707>
- Middleton, G., Golley, R., Patterson, K., Le Moal, F., & Coveney, J. (2020). What can families gain from the family meal? A mixed-papers systematic review. *Appetite*, 153. <https://doi.org/10.1016/j.appet.2020.104725>. Article 104725.
- Musher-Eizenman, D., & Holub, S. (2007). Comprehensive Feeding Practices Questionnaire: Validation of a new measure of parental feeding practices. *Journal of Pediatric Psychology*, 32(8), 960–972. <https://doi.org/10.1093/jpepsy/ism037>

- Neuhauser, H., Schienkiewitz, A., Rosario, A. S., Dortschy, R., & Kurth, B.-M. (2013). *Referenzperzentile für anthropometrische Maßzahlen und Blutdruck aus der Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland (KiGGS)*. Robert Koch Institute. <https://doi.org/10.25646/3179>
- Øverby, N. C., Hillesund, E. R., Røed, M., & Vik, F. N. (2020). Association between parental feeding practices and shared family meals. The Food4toddlers study. *Food & Nutrition Research*, 64. <https://doi.org/10.29219/fnr.v64.4456>
- Robson, S. M., McCullough, M. B., Rex, S., Munafò, M. R., & Taylor, G. (2020). Family meal frequency, diet, and family functioning: A systematic review with meta-analyses. *Journal of Nutrition Education and Behavior*, 52(5), 553–564. <https://doi.org/10.1016/j.jneb.2019.12.012>
- Roos, E., Pajunen, T., Ray, C., Lynch, C., Kristiansdottir, Á. G., Halldorsson, T. I., Thorsdottir, I., te Velde, S. J., Krawinkel, M., Behrendt, I., de Almeida, M. D. V., Franchini, B., Papadaki, A., Moschandreas, J., Ribič, C. H., Petrova, S., Duleva, V., Simčič, I., & Yngve, A. (2014). Does eating family meals and having the television on during dinner correlate with overweight? A sub-study of the pro greens project, looking at children from nine European countries. *Public Health Nutrition*, 17(11), 2528–2536. <https://doi.org/10.1017/S1368980013002954>
- Rosemond, T. N., Blake, C. E., Shapiro, C. J., Burke, M. P., Bernal, J., Adams, E. J., & Frongillo, E. A. (2019). Disrupted relationships, chaos, and altered family meals in food-insecure households: Experiences of caregivers and children. *Journal of the Academy of Nutrition and Dietetics*, 119(10), 1644–1652. <https://doi.org/10.1016/j.jand.2019.05.005>
- RStudio Team. (2020). *RStudio*. Integrated Development Environment for R (1.3.959) [Computer software]. RStudio, PBC. URL <http://www.rstudio.com/>.
- Skafida, V. (2013). The family meal panacea: Exploring how different aspects of family meal occurrence, meal habits and meal enjoyment relate to young children's diets: The family meal panacea. *Sociology of Health & Illness*, 35(6), 906–923. <https://doi.org/10.1111/1467-9566.12007>
- Sweetman, C., McGowan, L., Croker, H., & Cooke, L. (2011). Characteristics of family mealtimes affecting children's vegetable consumption and liking. *Journal of the American Dietetic Association*, 111(2), 269–273. <https://doi.org/10.1016/j.jada.2010.10.050>
- Trofholz, A. C., Tate, A. D., Miner, M. H., & Berge, J. M. (2017). Associations between TV viewing at family meals and the emotional atmosphere of the meal, meal healthfulness, child dietary intake, and child weight status. *Appetite*, 108, 361–366. <https://doi.org/10.1016/j.appet.2016.10.018>
- Vlahovic, T. A., Roberts, S., & Dunbar, R. (2012). Effects of duration and laughter on subjective happiness within different modes of communication: Happiness and mode of communication. *Journal of Computer-Mediated Communication*, 17(4), 436–450. <https://doi.org/10.1111/j.1083-6101.2012.01584.x>
- Wickham, H., Chang, W., Henry, L., Pedersen, T. L., Takahashi, K., Wilke, C., Woo, K., Yutani, H., Dunnington, D., & RStudio. (2021). *ggplot2: Create elegant data visualisations using the grammar of graphics*, 3.3.4 [Computer software] <https://CRAN.R-project.org/package=ggplot2>.