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1   **INTRODUCTION**

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3   Family meals have been identified as a key factor in the home environment to promote positive

4   health behaviors in children and adolescents. Family meals have been positively associated with

5   healthy eating behaviors[1,2], improved dietary quality[3], psychosocial outcomes[4-6] and reduced

6   engagement in high-risk behaviors.[7-9] Due to these relationships, family meals are hypothesized

7   to play a protective role for children and often recommended for health promotion.[10-12] The

8   Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of

9   Child and Adolescent Overweight and Obesity specifically encourage family meals where the

10   parent and child eat together, as a target behavior for obesity prevention.[12]

11   Due to the presence of food at family meals, outcomes naturally have often focused on

12   dietary intake or nutrition-related outcomes. Results of a systematic review examining the

13   influence of family meals on dietary intake in adolescents suggested family meals may improve

14   dietary intake and quality, but cautioned about the complexity of today's families (such as family

15   structures, living arrangements, and employment demands), and the need for inclusion of

16   mediating/confounding factors.[13] The first study to use meta-analytic methods to examine the

17   association between family meal frequency ($\geq$3 meals/ week to <3 meals/week) and nutrition

18   health outcomes found there to be a 20% reduction of odds of eating unhealthy foods and a 24%

19   increased odds of eating heathy foods in children and adolescents when families shared at least 3

20   meals per week.[1] The definitions used to define a family meal varied across studies. Besides the

21   study by Hammons and colleagues[1] that reported on unhealthy and healthy eating there has not

22   been a meta-analysis conducted to understand the association between family meal frequency

23   and specific dietary outcomes (e.g. fruits and vegetables [FVs], sugar sweetened beverages

24   [SSBs]) commonly targeted as part of dietary interventions.

25   While family meals are believed to be important, there has been less of a focus on

26   possible underlying mechanisms for the relationship between family meals and positive health

27   behaviors. It is well-documented that family-based interventions are associated with

28   improvements in child and parent health behaviors.[14] Many of these interventions target

29   components of family functioning, which include dimensions of family connectedness or

30   cohesion, communication, expressiveness, and conflict/problem-solving. Studies have shown

31   that improvements in family functioning have been associated with psychosocial wellbeing

32   among children and adolescents with chronic medical conditions and psychiatric conditions.[15-18]

33   Family functioning can be assessed through observations of a family meal because the way a

34   family responds to a family meal is indicative of the family's overall family functioning,

35   indicating family meals could be hypothesized to be a proxy for family functioning.[19,20] To date

36   no systematic reviews or meta-analyses have examined the relationship between family meal

37   frequency and family functioning outcomes.

38   While numerous individual studies have examined family meal frequency and various

39   outcomes there is a need for a more comprehensive understanding. Thus, to expand upon

40   previous reviews and literature about family meal frequency and dietary outcomes that have

41   often been limited to a single dietary outcome (e.g. FV intake), and the limited understanding of

42   the connection between family meal frequency and family functioning outcomes, the primary

43   purpose of this systematic review and meta-analysis was to explore the direction and magnitude

44   of exposure to family meals and dietary and family functioning outcomes in children. Meta-

45   analyses were performed only when adequate data existed. It was hypothesized that more

46 frequent family meals would be associated with better dietary outcomes and family functioning

47 outcomes.

METHODS

49

50 The meta-analysis of observational studies in epidemiology (MOOSE) reporting guidelines have

51 been adhered to in preparation of this manuscript.[21]

Search Strategy

53 Our search strategy was guided by the Cochrane handbook.[22] Two separate searches, one for

54 each outcome of interest, were conducted across 5 databases including PubMed, CINAHL, Web

55 of Science, Scopus and PsycINFO. The key search terms used included ("family meals" or

56 "shared meals" or "family mealtime") and ("family functioning" or "family cohesion" or "family

57 relations" or "nuclear family" or "communication" or "interpersonal") or "dietary intake." Each

58 search was established in PubMed by a Senior Assistant Librarian and translated to each of the

59 subsequent search engines utilized. An example of the complex search strategy used for PubMed

60 is available in a supplementary file online.

Study Selection Criteria

62 Studies selected were full length manuscripts published in a peer reviewed journal in English

63 prior to December 2018 and met the following inclusion criteria: participants were children (2-18

64 years-old); interventions/exposures of family meal frequency; outcomes included dietary intake

65 or family functioning; had a study design that was cross-sectional, longitudinal cohort, or

66 randomized. Case studies, commentaries, methods or questionnaire development, narrative or

67 systematic reviews, and feeding studies were excluded. Dissertations and theses were also not

68 included due to the lack of peer review and potential lack of rigor. Only studies conducted in the

69 United States were included (due to the nationally-focused promotion of family meals through

70 organizations such as the American Academy of Pediatrics, and examining cultural differences

71 was not within the scope of this review).

72 **Data Extraction**

73 The titles and abstracts of all studies were screened by 2 independent reviewers with expertise in

74 nutrition and psychology (SMR, MBM) using the established eligibility criteria. Disagreements

75 were resolved through discussion. If inadequate information was provided by the title and/or

76 abstract the article was included for full-text review. Data were independently extracted by 2

77 authors for dietary (SMR, SR) and family functioning (SMR, MBM) outcomes and discrepancies

78 were resolved by consensus. Extracted data included first author, primary data source, study

79 design, exposure and outcome variables, location, participant characteristics and outcomes.

80 Authors were contacted for 4 studies to obtain additional data.

81 Frequency of family meals (defined as a minimum of a child eating a meal with a least 1

82 other individual at home) was captured in many different ways across studies. Response options

83 were often indicative of a week time frame and include an absolute number (0-7) or category

84 (such as 'never' '1-2 times' '3-6 times' '7 or more times'). Several studies focused on regular or

85 frequent family meals but definitions varied from ≥3 meals per week, ≥5 meal per week, or ≥6

86 meals per week. Fewer studies individually assessed family meal frequency by meal type

87 (breakfast, lunch, dinner).

88 Dietary outcomes were considered across 8 categories including fruits, vegetables, fruits

89 and vegetables (FVs), diet quality (as measured by the Healthy Eating Index [HEI]), sugar

90 sweetened beverages (SSBs), snack foods, fast food, or desserts. Definitions of dietary outcomes

91 varied greatly depending upon the measure used and cutoffs established. Most often frequency of

92 consumption (per day or per week) was measured by a food frequency-type questionnaire. Only

93 one study[4] assessed dietary outcomes with 24-hour recalls. Given the diversity of dietary

94 assessment methods, there were not criteria for exclusion related to assessment method of dietary

95 outcomes.

96   Outcome measures of family functioning had to have at least 1 dimension of family

97 functioning (family connectedness/cohesion, communication, expressiveness, or

98 conflict/problem-solving) to be included.

99 **Methodological Quality Assessment**

100 Two authors independently (SMR, SR) assessed study quality using the Quality Assessment

101 Tool for Observational Cohort and Cross-Sectional Studies from the National Heart, Lung, and

102 Blood Institute of the National Institutes of Health.[23] The Quality Assessment Tool was used to

103 assess each study based upon the research question, study population, sample size justification,

104 exposure measurement and timing, outcome measurement, blinding of outcome assessors,

105 follow-up rate, and statistical analyses. Studies were assigned an overall quality score of "good"

106 (indicating the least risk of bias), "fair" (the study is susceptible to some bias not sufficient to

107 invalidate its results), or "poor" (indicating significant bias).[23] Authors discussed any divergence

108 in ratings and reached an agreement on the final rating.

109 **Data Analysis**

110 Studies' effect estimates were pooled only where there were 3 or more studies that provided

111 adequate data for meta-analysis, were of the same study design (i.e., longitudinal or cross

112 sectional) and had comparably defined exposures and outcome variables to ensure that bias could

113 be reduced when measuring heterogeneity using I^2.[24,25] Effect estimates were pooled to result in

114 the standardized mean difference for cross-sectional studies, and the standardized mean

115   difference in change from baseline to final follow-up for longitudinal or cohort studies. No

116   randomized trials were included as none were identified in the published literature. Where

117   studies only reported odds ratios and 95% confidence intervals (i.e., or other measure of

118   variation), these data were converted using a standard formula to Cohen's d to allow inclusion in

119   the meta-analysis.[22] Where there were an adequate number of studies (determined after a request

120   to authors for unpublished data), effect estimates were pooled using a random effects model in

121   Stata 15 MP using the DerSimonian & Laird method[26], with the estimate of heterogeneity (I^2)

122   being taken from the inverse-variance fixed-effect model. Interpretation of I^2 used the following

123   ranges: 0-40% might not be important, 30-60% may represent moderate, 50-90% may represent

124   substantial, and 75-100% is considerable, as outlined in the Cochrane Handbook.[22] The higher

125   the I^2 the more variability in the results. Funnel plot asymmetry and small study bias were not

126   assessed due to an inadequate number of studies.[22,27]

127   **RESULTS**

128

129   **Overview of Included Studies**

130   A total of 1,241 studies were identified for dietary outcomes; 890 were reviewed after 349

131   duplicates were removed, and 87 were selected for full-review. Thirty-one articles[3,4,28-56] met

132   study inclusion criteria, were included in the systematic review (supplementary material, Table

133   1), and of those articles 8[3,4,51-56] in the meta-analysis (Figure 1a). For family functioning

134   outcomes 1,982 articles were identified; 1,433 were reviewed after 549 duplicates were removed,

135   and 83 were selected for full-review. Twelve articles[4,51,52,57-65] met all study inclusion criteria,

136   were included in the systematic review (supplementary material, Table 2), and of those articles

137   4[4,51,64,65] in the meta-analysis (Figure 1b).

138   Across all studies 81.4% had a cross-sectional design and 18.6% used a longitudinal

139   design. All studies included in meta-analyses had a cross-sectional design. Baseline sample sizes

140   ranged from 50 to 99,426 with the majority having a similar proportion of females and males

141   when reported, except for 1 study by Bauer et al.[36] that was all female. Of studies included

142   62.8% included potential confounding variables as adjustments in models. Within each dietary

143   outcome results from all studies included in the systematic reviews are first described based upon

144   study design (cross-sectional, longitudinal) followed by studies only included in the meta-

145   analysis when applicable. Given studies with family functioning outcomes were all cross-

146   sectional, results are presented as all studies included in the systematic review followed by meta-

147   analysis results.

148   **Dietary Outcomes**

149   Many of the selected articles included more than 1 dietary outcome in relationship to family

150   meal frequency. Of the 31 articles included in the systematic review the majority reported

151   outcomes for fruits[29-35,37,38,40-42,49,51,54] (n = 15, 48.4%), vegetables[29-35,37,38,40-42,49,51,54] (n = 15,

152   48.4%) and/or FVs[4,28,29,33,36,39,42,44,48,52,53,55,56] (n = 13, 31.9%). SSBs[4,28,30,32,34,36,40-44,49,51,54] (e.g.,

153   soft drinks, soda) was an outcome in 14 (45.2%) articles. Fewer articles investigated the

154   relationship of family meal frequency to snack foods[28,29,33,40,43,44,49-51] (n = 9, 29.0%), diet

155   quality[3,4,45-47] (n = 5, 16.1%), fast food[33,41,56] (n = 3, 9.7%) or desserts[28] (n = 1, 3.2%).

156   **Fruits, Vegetables, and FVs**

157   Overwhelmingly, studies showed a positive relationship between family meal frequency and fruit

158   and vegetable intake when examined separately, but also when FV intake were combined.

159   Within each type of study fruit and vegetable outcomes are first presented separately followed by

160   FV outcomes.

161   *Cross-sectional.* Correlations showed family meal frequency was positively related to fruit

162   intake[35,41] (r = 0.15 to 0.25, *P*s ≤ .05); however, only 1 of the 2 studies found this relationship for

163   vegetable[41] intake (r = 0.32, *P* < .05). When looking at trends in fruit intake and vegetable intake

164   across varying levels of frequency of family meals, the majority of data support a positive

165   relationship whereby as frequency of family meals increased so did intake of both fruits and

166   vegetables.[29,31,38,42,49] In contrast, Welsh and colleagues[51] did not find evidence of association

167   between family meal frequency and fruit or vegetable intake in adolescents. Feldman and

168   colleagues[40] also did not find evidence of an adjusted association in vegetable intake, but did in

169   fruit intake. Examination of the association between family meal frequency and fruit and

170   vegetable intake within age groups (0-5 years, 6-11 years, 12-17 years) using adjusted models

171   found no evidence in 0-5 year-olds, an association with vegetables only in 6-11 year-olds and an

172   association for both fruits and vegetables in 12-17 year-olds.[54]

173   Several studies focused on the frequency of a specific meal (breakfast, lunch or dinner)

174   and fruit and vegetable intake. When examining breakfast family meal frequency, 2 studies[30,37]

175   found evidence of a relationship with fruit intake, but not vegetable intake. These same findings

176   were shown for lunch family meal frequency.[37] Examination of only the dinner family meal

177   showed inconsistent findings. Dinner family meal frequency examined by Fulkerson and

178   colleauges[42] found a difference in daily servings of fruit intake when examining 5-7 family

179   dinner meals per week compared to no family dinner meals per week (5-7 days/week: 2.4 ± 0.26

180   vs. Never: 1.2 ± 0.37, *P* < .05); however, there was no clear statistical evidence for this when

181   examining daily servings of vegetable intake. Another study examining family dinner frequency

182   found the odds of eating fruits (≥ 2 times/day) and vegetables (≥ 3 times/day) increased with

183   regular family dinner meals (5-7 dinners/week) in adolescent females; however, in males this

184   relationship was only seen in fruit intake not vegetable intake.[32] Similarly, in adolescents the

185   odds of not eating 2+ vegetables and 2+ fruits decreased as the number of evening family meals

186   increased.[38] Based upon a food frequency questionnaire completed by the oldest school age child

187   in limited resource families, dinner family meal frequency was not related to either fruit intake or

188   vegetable intake.[37]

189   Fruits and vegetables were also combined as an outcome. One study[28] reported a

190   correlation between the number of family meals in the past week and FV intake (r = 0.18, *P* <

191   .05). Intake of FVs was shown to increase as family meal frequency inceased[29] and there was

192   evidence of an association between regular family meal (≥5 times/week) consumption and FV

193   intake.[52] Berge and colleagues[56] found family meal frequency to be associated with FV intake in

194   girls (β = 0.14. *P* <.001) and boys (β = 0.14. *P* < .001); however, in a study[36] examining only

195   adolescent girls (β = 0.08. *P* = .69) frequency of family meals was not found to be associated

196   with FV intake. In contrast Watts and colleagues found no evidence of association between

197   family meal frequency and FV intake.

198   The frequency of individual meals (breakfast, lunch, dinner) were also examined with FV

199   intake. One study by Andaya and colleagues[48] examined breakfast and lunch and found evidence

200   of an association for consumption of a breakfast family meal (≥4 times/week) and FV intake (*P* =

201   .04), but not for lunch. Of the 5 studies that focused on dinner family meal frequency and the

202   relationship to FV intake, 3 studies[4,53,55] found evidence of a positive relationship, whereby more

203   frequent dinner family meals were associated with higher intakes of FV; however, 2[42,48] studies

204   showed no evidence for this relationship.

205   *Longitudinal.* When looking at trends in fruit intake and vegetable intake separately across

206   varying levels of family meal frequency Larson and colleagues[31] found a positive linear trend

207   across categories of family meal frequency (never to 7+ times) for both fruits and vegetables,

208   even after adjustments that included Time 1. Examination of family meal frequency defined as

209   regular family meals ($\geq$ 5 meals/week), was associated with vegetable servings in male and

210   female adolescents, but with fruit servings in males only.[34]

211   Frequency of family meals was shown to be associated with combined FV intake (βest =

212   0.33 ± 0.05, $P = < .001$)[44] and a vegetable and fruit dietary pattern ($\beta = 0.06$, p < 0.0001)[33] at

213   Time 2 in adolescents. When looking at the relationship between family meal frequency and

214   combined FV intake by racial/ethnic groups, family meal frequency declined from kindergarten

215   to eighth grade for Non-Hispanic White, Non-Hispanic Black and Hispanic children, and this

216   change was associated with fruit and vegetable intake in eighth grade (Non-Hispanic White: β =

217   0.14 ± 0.05, $P < .01$; Non-Hispanic Black: $\beta = 0.43 \pm 0.20$, $P < .05$; Hispanic: $\beta = 0.20 \pm 0.11$, P

218    $< .10$).[39] This association was not found in Asian children.[39]

219   *Meta-analysis.* Meta-analyses indicated little evidence for an association between frequency of

220   family meals and fruit consumption in cross-sectional studies[51,54] (Figure 2). The estimate was

221   imprecise (standardized mean difference (SMD) 0.19, 95% CI: -0.02 to 0.40, N= 4), with

222   substantial between-study heterogeneity ($I^2 = 69.4\%$). For vegetable intake, higher frequency of

223   family meals was weakly associated with higher vegetable consumption in cross-sectional

224   studies[51,54] (Figure 2) (SMD 0.29, 95% CI: 0.14 to 0.43, N = 4), with no between-study

225   heterogeneity ($I^2 = 0.0\%$). More frequent family meals[52,55,56] (Figure 2) and more frequent dinner

226   family meals[4,53] (Figure 2) were weakly associated with higher fruit and vegetable consumption

227   in cross-sectional studies. These studies showed substantial between-study heterogeneity for

228   family meal frequency ($I^2 = 40.9\%$), but no between-study heterogeneity for family dinner

229   frequency ($I^2 = 0.0\%$).

230 **SSBs**

231 *Cross-sectional.* Of the 14 studies assessing SSB outcomes 12 were cross-sectional and show

232 mixed results. Two studies[28,41] found negative correlations between family meal frequency and

233 SSB intake (r = -0.05 to -0.24, *P*s < .05) while Fulkerson and colleauges[42] and Erinosho and

234 colleagues[49] found no difference in regular soda intake and soft drinks, respectively by family

235 meal frequency. Four studies[4,36,43,51] using regression analysis found no association between

236 family meal frequency and SSB intake. Larson and colleagues[30] found an inverse association

237 between breakfast frequency and SSBs in adolescents only when the adjusted model included

238 total energy intake. Fink and colleagues[54] reported adjusted associations between family meal

239 frequency and no SSBs in young children ([0-5 years] OR = 2.04, 95% CI: 1.06, 393, *P* = .033)

240 and older children ([6-11 years], OR = 2.12, 95% CI 1.27, 3.55, *P* = .026), but not in adolescents

241 (12-17 years). Feldman and colleauges[40] showed higher consumption of SSBs (median daily

242 serving) in girls with no family meals as compared to family meals (both with and without TV),

243 while in boys SSB intake (median daily servings) did not differ between family meals (with TV)

244 and no family meals. SSB intake in both of these categories did differ from SSB intake in family

245 meals (with no TV). Demissie and colleauges[32] also investigated females and males separately

246 and found that eating dinner 5-7 times per week with a parent or guardian was associated with a

247 lower odds of consuming SSBs (≥3 times/day) in U.S. female high school students (OR = 0.77,

248 95% CI: 0.63, 0.94), but not U.S. male high school students (OR = 1.02, 95% CI: 0.83, 1.25).

249 *Longitudinal.* Both Burgess-Champoux and colleauges[34] and Lipsky and colleagues[44], who

250 conducted longitudinal studies found family meal frequency was not associated with SSB

251 consumption.

252 *Meta-analysis.* Meta-analysis indicated little evidence for an association between frequency of

253 family meals and SSB consumption in cross-sectional studies[51,54] (Figure 2). The estimate was

254 imprecise (SMD -0.21, 95% CI: -0.41 to -0.01, N = 4), with substantial between-study

255 heterogeneity (I^2=57.7%).

256 **Snack Foods**

257 *Cross-sectional.* Four[28,29,43,51] of the 7 cross-sectional studies investigating family meal

258 frequency and snack foods as a dietary outcome found there was a lack of statistical evidence for

259 a relationship. Two studies that examined this relationship by sex. Feldman and colleagues[40]

260 found clear evidence of higher intake of snack foods (in median daily servings) in girls who had

261 no family meals as compared to family meals (no family meals: 2.4 vs. family meals: 2.2, $P \leq$

262 .05), but there was no clear evidence of an association in boys. In contrast, Larson and

263 colleagues[50] found frequency of family meals was associated with energy-dense snack food

264 intake in the mutually-adjusted model ($\beta = 0.10$, $P = .04$); however, there was no clear evidence

265 of association in models by sex. A study by Erinosho and colleagues[49] showed a decrease in the

266 odds of a child consuming snack foods ≥3 times/week as compared to ≤2 times/week when

267 family meals frequency was ≤6 days per week; however, statistical significance was not

268 reported.

269 *Longitudinal.* Cutler and colleagues[33] report a negative association between family meal

270 frequency and a sweet and salty snack food pattern ($\beta = -0.03$, $P = .02$) at Time 1, but not Time

271 2. Lipsky and colleagues[44] did not find clear evidence of association between family meal

272 frequency and snack intake.

273 **Diet Quality**

274   *Cross-sectional.* All studies examining diet quality, measured by HEI, as an outcome were cross-

275   sectional. Regular family meals when defined as ≥3 (as compared to < 3 family meals/week)

276   were not associated with HEI (β = 0.13, 95%CI: -0.82 to 1.07, *P* = .79)[47]; however, in children

277   with Type 1 diabetes, regular family meals defined as ≥5 (as compared to < 5 family meals/

278   week) found weak evidence of a relationship with HEI (54.5 vs. 51.7, *P* = .047).[46] Berge and

279   colleagues[3] examined associations for breakfast, lunch and dinner frequency and preschool child

280   HEI score in Hispanic and Non-Hispanic households. Only breakfast frequency was associated

281   with preschool child HEI total score (β = 1.3 *P* = .001) in Non-Hispanic households. Total meal

282   frequency was also found to be associated (β = 0.38, *P* = .01). In contrast to these findings of

283   Berge and colleagues[3], when focused only on family breakfast frequency there was no clear

284   evidence that HEI score differed by family breakfast frequency among boys (mean ± SE); never:

285   52.3 ± 1.6 vs. 1-2 times/week: 50.5 ± 1.7 vs. 3-7 times/week: 52.0 ± 1.7, *P* = .44) or girls (mean

286   ± SE); never: 53.8 ± 1.4 vs. 1-2 times/week: 54.0 ± 1.6 vs. 3-7 times/week: 54.0 ± 1.8, *P* =

287   .99).[45] When only dinner family frequency was examined it was found to be associated with a

288   higher HEI score (β = 0.77, *P* <0.05). Taken together there are inconsistent findings for the

289   relationship between family meal frequency and HEI.[4]

290   *Meta-analysis.* There was weak evidence for an association between frequency of family dinner

291   and HEI in cross-sectional studies[3,4] (Figure 2). The estimate was imprecise (SMD 0.72, 95% CI:

292   0.06 to 1.38, N=3), with substantial between-study heterogeneity (I^2 = 69.9%).

293   **Fast Food**

294   *Cross-sectional.* Two cross-sectional studies demonstrated no clear statistical evidence for a

295   relationship between family meal frequency and fast food consumption.[41,56]

296   *Longitudinal.* Only 1 study[33] found clear evidence of an inverse relationship between family

297   meal frequency at Time 2 and fast food (β = -0.07, P < .001).

298   **Desserts**

299   *Cross-sectional.* There was no clear evidence of a correlation between number of family meals in

300   the past week and dessert consumption.[28]

301   **Family Functioning Outcomes**

302   Nearly all the studies included in the systematic review and meta-analysis demonstrated a

303   positive relationship between family meal frequency and measures of family functioning.

304   *Cross-sectional studies.* Two studies found positive correlations between family meal frequency

305   and family connectedness (r = 0.27, P <.001)[64] and family cohesion (r = 0.41, P <.01).[51] Children

306   who had family meals more frequently (defined as ≥5 times/week or usually/always) had higher

307   scores related to parent communication as compared to children who had infrequent family

308   meals (<2 times/week or never/almost never)[52]. When comparing family functioning scores by

309   family meal frequency, adolescent girls with family functioning scores at the 95th percentile had

310   more family meals per week as compared to those who had family functioning scores at the 5th

311   percentile (95th: 5.12 vs. 5th: 2.62, P < .001).[61] The same relationship was also shown for

312   adolescent boys.[61] High family cohesion was shown to predict frequent family meals (β = 0.87, P

313   < .10), while low family cohesion predicted less frequent family meals (β = -3.38, P < .01).[63]

314   Family functioning was also found to moderate the relationship between family meal frequency

315   and disordered eating behavior outcomes in a study by Loth and colleagues.[57]

316   Three studies specifically examined only dinner family meal frequency. Lawrence and

317   colleagues[62] found a positive correlation between dinner family meal frequency and family

318   communication (r = 0.25, P = <.05). Two of the studies[4,65] demonstrated evidence for a positive

319 association between dinner family meal frequency and family functioning (family

320 communication and family connectedness).

321 *Longitudinal*. Of the 3 longitudinal studies 1 study[60] examined the relationship between overall

322 family meal frequency and family functioning outcomes, while 2 studies[58,59] specifically focused

323 on dinner family meal frequency. All 3 studies found evidence of an association between family

324 meal/dinner frequency and family functioning outcomes (family cohesion, parent-child

325 communication, parent-child relationship).

326 *Meta-analysis.* Meta-analysis results (Figure 3) showed that more frequent family meals were

327 moderately associated with higher family functioning in cross-sectional studies[51,64] (SMD 0.56,

328 95% CI: 0.50 to 0.62, $I^2 = 0\%$, N = 3), and when dinner family meals were examined they were

329 also more frequent dinner family meals were moderately associated with higher family

330 functioning in cross-sectional[4,65] studies (SMD 0.46, 95% CI: 0.27 to 0.65, N = 3), with

331 substantial between-study heterogeneity ($I^2 = 59\%$).

332   **DISCUSSION**

333

334 In nutrition, family meals have often been promoted due to the relationship between more

335 frequent family meals and a healthier dietary intake. This study systematically reviewed the

336 literature to examine the direction and magnitude of the association between family meal

337 frequency, multiple dietary outcomes, and family functioning outcomes in children. Once

338 duplicates were removed of the 892 and 1,433 articles related to dietary outcomes and family

339 functioning outcomes respectively, only 8 were included in the meta-analysis for dietary

340 outcomes and 4 articles for family functioning.

341   Similar to a previous systematic review[66], in general family meal frequency was most

342   often positively related to FV consumption. When FVs were examined separately, findings were

343   not always consistent between fruit intake and vegetable intake. As dietary intake is typically

344   reflective of a child's overall diet it would be important to further assess if greater consumption

345   of fruits or vegetables is occurring because parents are more likely to offer fruits or vegetables at

346   family meals resulting in an increase in intake. When combined, FV intake only showed a weak

347   correlation; however, being more specific about the meal (e.g., family dinner frequency) reduced

348   the between-study heterogeneity, which may be expected. Horning and colleagues[4] had

349   demonstrated that when family dinner frequency was specified, despite differences in 9

350   assessment measures of family dinner frequency, results consistently showed family dinner

351   frequency to be positively correlated with FV intake. Perhaps, these findings underscore the

352   importance of assessing family meal frequency by meal type.

353   In addition to FVs, SSBs are often a dietary behavior targeted for change in children

354   likely due to their inclusion in obesity prevention and treatment recommendations.[12] Studies

355   included in the systematic review demonstrated mixed results while the meta-analysis indicated

356   positive relationships between family meal frequency and dietary outcomes (FV, SSBs) and

357   family functioning outcomes, but confidence intervals were wide indicating a need for a greater

358   number of large, high quality studies to determine if there is a true association and sufficient

359   magnitude to be of public health importance. SSBs were defined diversely (e.g. some defined as

360   soft drinks, soda) likely contributing to the between study heterogeneity.

361   Very few studies included in this systematic review and meta-analysis examined other

362   food categories (e.g., snack foods, fast food, desserts) or overall diet quality. These findings in

363   combination with the mixed results of this systematic review indicate a need for stronger

364   evaluation of the family meal frequency literature and specifically the impact or lack of impact

365   on dietary outcomes.

366   To better elucidate the relationship between family meal frequency and dietary outcomes

367   identifying possible underlying mechanisms, such as family functioning, are needed.[7] The

368   positive relationship between greater family meal frequency and higher family functioning

369   indicates that family meal frequency may serve as a proxy for family functioning. Several studies

370   have noted the independent effects of family functioning measures (e.g., family connectedness)

371   on psychosocial outcomes.[67] In addition many studies[5,8,30,62,68,69] have adjusted for family

372   functioning during analyses, limiting the ability to identify the effect. Furthermore, a mealtime

373   observation using an assessment tool such as the McMaster Mealtime Interaction Coding

374   System[70] is often used to assess family functioning, indicating the interrelated nature of these

375   two factors. Studies from Project EAT have provided the foundation for much of the work in

376   family meals.[8,10,20,29,52,69,71-73] A review of what has been learned published in 2010 raised the

377   question, if family meals are a marker for better family functioning or some other familiar

378   characteristic.[72] To date this question has yet to be sufficiently answered.

379   **Potential Bias in Review Reporting**

380   This study may suffer from publication bias given this systematic review focused on peer

381   reviewed published data. While funnel plots can aid in the detection of publication bias there

382   were a limited number of studies with the same study design, exposure and/or outcome variables.

383   Given this few studies were available for meta-analysis and thus were unable to conduct funnel

384   plots to examine small study bias (i.e. at least 10 studies are needed for funnel plots[22]).

385   **Study Quality**

386   Findings should be considered within the quality of studies used as part of the systematic review

387   and meta-analyses. Based upon the Quality Assessment Tool for Observational Cohort and

388   Cross-Sectional Studies 3 studies received a "good" rating, 1 a "poor" rating, and the rest

389   received a "fair" rating. A "fair" rating most commonly resulted due to lack of sample size

390   justification, exposure and outcome variables being measured at the same time point, limited

391   number of exposure measurements, lack of information regarding assessor blinding and lack of

392   applicability of follow-up rate. This was not surprising given the predominant use of a cross-

393   sectional study design.

394   **Strengths and Weaknesses**

395   This study expands the literature on family meals given the number of dietary outcomes included

396   and the use of meta-analysis when statistically appropriate. A comprehensive search was

397   conducted across 5 databases; however, the findings should be interpreted within the context of

398   the study's limitations. This study reviewed full texts of studies whereby the primary aim was

399   not similar, thereby including studies that may have been excluded at the title/abstract screening

400   stages. Standard and complex formulas as outlined in the Cochrane handbook[22] were used to

401   convert effect estimates that were not obviously appropriate for meta-analysis. Where data were

402   not available authors of studies were contacted, and unpublished data were obtained, overcoming

403   some possible publication bias. Due to specific eligibility criteria (e.g., conducted in the United

404   States) the generalizability to populations in other countries may be limited. Eligibility criteria

405   were also established based upon the research question perhaps limiting the number of articles

406   included in this systematic review and meta-analysis.

407   **Guidelines for Future Research**

408   The methodological diversity across studies indicates a need to standardize measures in regards

409   to cut-offs and reporting of family meal frequency and dietary and family functioning-related

410   outcomes. These findings related to methodological diversity have been well cited in previously

411   published review papers.[2,7] The variation of family meal definitions, and the need for validated

412   procedures has been well described by Martin-Biggers and colleagues.[66] Furthermore, research

413   using experimental study designs, especially randomized controlled trials are warranted to better

414   evaluate the magnitude and causality of family meal frequency on outcomes like diet.[2]

415   Standardization of family meal measures will also allow for more robust analyses in the future.

416   **IMPLICATIONS FOR RESEARCH AND PRACTICE**

417

418   There is a positive relationship between family meal frequency and dietary outcomes specifically

419   when examining fruit and vegetable intake. The direction and magnitude of the relationship to

420   additional dietary outcomes such as SSBs, snack foods, fast food, desserts, and diet quality has

421   been investigated less. Family meal frequency may serve as a proxy for family functioning, but

422   research is needed to confirm this finding. To continue to move the family meal literature

423   forward, standardized measures of family meals and associated outcomes in addition to

424   interventions examining the effect of family meals are warranted.

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632

633   **Figure Captions**

634   Figure 1. Consort Diagrams for Family Meal Frequency and Dietary Outcomes (Figure 1a) and

635   Family Functioning Outcomes (Figure 1b).

636

637   Figure 2. Pooled standardized mean differences and 95% confidence intervals for cross-sectional

638   associations between family meals and dietary outcomes.*

639   Note: *Berge, 2014a Boys, Berge, 2014b Girls, Fink, 2014a Younger Children (Birth to 5

640   Years), Fink, 2014b Older Children (6-11 years), Fink, 2014c Adolescents (12-17 years),

641   Horning, 2016a Parent-reported, Horning 2016b Child-reported

642

643   Figure 3. Pooled standardized mean differences and 95% confidence intervals for cross-sectional

644   associations between family meals and family connectedness.*

645   Note: *Horning, 2016a Parent-reported, Horning 2016b Child-reported, Welsh, 2011a

646   Adolescent-reported, Welsh, 2011b Parent-reported