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Effect of Pasta in the Context of Low Glycemic Index Dietary Patterns on Body Weight and Markers of Global Adiposity: A Systematic Review and Meta-analysis of Randomized Controlled Trials in Adults

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3 1 **Effect of Pasta in the Context of Low Glycemic Index Dietary Patterns on Body Weight**
4 **and Markers of Global Adiposity: A Systematic Review and Meta-analysis of Randomized**
5 **Controlled Trials in Adults**
6
7

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28 24 **Keywords:** body weight, pasta, glycemic index, glycaemic index, systematic review and meta-
29 25 analysis, weight loss

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1
2
3 **29 ABSTRACT**
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5 **30 Objective:** Carbohydrates have been implicated in the epidemic of obesity. To assess the effect
6
7
8 **31** of pasta alone or pasta in the context of low glycemic index (GI) dietary patterns on adiposity,
9
10 **32** we conducted a systematic review and meta-analysis.
11

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13 **33**
14 **34 Design:** Systematic review and meta-analysis of randomized controlled trials (RCTs) with
15
16
17 **35** GRADE assessment.
18

19 **36**
20
21 **37 Eligibility criteria for selecting studies:** MEDLINE, Embase, CINAHL, and the Cochrane
22
23
24 **38** Library were searched through 07 February 2017. We included RCTs of ≥ 3 -weeks assessing the
25
26 **39** effect of pasta alone or pasta in the context of low-GI dietary patterns on measures of global
27
28 **40** (body weight, BMI, body fat) and regional (waist circumference [WC], waist-to-hip ratio
29
30 **41** [WHR], sagittal abdominal diameter [SAD]) adiposity in adults. Two independent reviewers
31
32 **42** extracted data and assessed risk of bias. Data were pooled using the generic inverse-variance
33
34 **43** method and expressed as mean differences (MDs) with 95% confidence intervals (95% CIs).
35
36 **44** Heterogeneity was assessed (Cochran Q statistic) and quantified (I²-statistic). GRADE assessed
37
38 **45** the overall quality of the evidence.
39
40
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43

44 **47 Results:** We identified no trials of the effect of pasta alone and 32 trial comparisons (n=2,448
45
46 **48** participants) of the effect of pasta in the context of low-GI dietary patterns. Pasta in the context
47
48 **49** of low-GI dietary patterns significantly reduced body weight (MD=-0.63kg [95% CIs, -0.84, -
49
50 **50** 0.42kg]) and BMI (MD=-0.26kg/m² [95% CIs, -0.36, -0.16kg/m²]) compared with higher-GI
51
52 **51** dietary patterns. There was no effect on other measures of adiposity. The evidence was graded as
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52 moderate for body weight, BMI, WHR, and SAD owing to a downgrade for indirectness and low
53 for WC and body fat owing to downgrades for indirectness and inconsistency.

54
55 **Conclusions:** The available RCTs demonstrate that pasta in the context of low-GI dietary
56 patterns does not adversely affect adiposity. Future trials should assess the effect of pasta in the
57 context of other healthy dietary patterns.

58
59 **Protocol registration:** ClinicalTrials.gov Identifier, NCT02961088

60 61 62 **Strengths and limitations of this study**

- 63 - The present systematic review and meta-analysis was based on a comprehensive search
64 and include a large number of randomized controlled trials which provide the best
65 protection against bias
- 66 - We used the Grading of Recommendations Assessment, Development, and Evaluation
67 (GRADE) system to evaluate the strength and quality of the evidence.
- 68 - There was evidence of unexplained inconsistency in the treatment estimates across trials
69 for waist circumference and body fat.
- 70 - The generalizability of our results is questionable with evidence of indirectness in the
71 pooled estimates for all body and adiposity outcomes, as all of the trials assessed pasta in
72 the context of low-GI dietary patterns (no trials assessed the effect of pasta alone or in the
73 context of other dietary patterns) and most of the available trials did not quantify the
74 amount of pasta consumed.

INTRODUCTION

As the role of saturated fat in chronic disease has been called into question, carbohydrates have come under attack in the media^{1,2}, popular books³⁻⁹, statements of health advocacy groups¹⁰ and commentaries in leading medical journals^{11,12}. Much of the attention has focused on sugars but traditional carbohydrate staples like pasta, rice, and breads are increasingly being implicated in the epidemics of overweight and obesity^{1,7}. Although advantages for weight related outcomes have been shown for dietary patterns that are high in these foods but low in glycemic index (GI)^{13,14}, high in whole grains^{15,16}, and/or high in dietary fibre^{17,18}, there has been a general lack of recognition of the importance of carbohydrate quality.

Pasta is an important example of a food which is considered a refined carbohydrate but has a low-GI, a property that has been exploited extensively in studies of low-GI dietary patterns. It remains unclear whether pasta alone or in the context of a low-GI dietary pattern contributes to weight gain. We undertook a systematic review and meta-analysis of randomized controlled trials (RCTs) with a full GRADE assessment to quantify the effect of pasta alone or in the context of low-GI dietary patterns on body weight and measures of adiposity relevant to the prevention and management of overweight and obesity.

METHODS

Design

Our protocol followed the guideline of the Cochrane Handbook for Systematic Reviews of Interventions¹⁹, and findings are reported according to the guidelines of the Preferred Reporting

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3 97 Items for Systematic Reviews and Meta-Analyses²⁰. The protocol is registered at
4
5 98 clinicaltrials.gov (identifier, NCT02961088).
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10 **Data sources and searches**

11
12 101 We searched MEDLINE (<http://www.nlm.nih.gov/bsd/pmresources.html>), Embase
13
14 102 (<https://www.embase.com>), CINAHL (<https://health.ebsco.com/products/the-cinahl-database>),
15
16 103 and the Cochrane Library (<http://www.cochranelibrary.com/>) through 07 February 2017. The full
17
18 104 search terms used in this study are presented in **Supplemental Tables S1-S2**. Briefly, we
19
20 105 searched using variations of the terms pasta and glycemic index and glycemic load and body
21
22 106 weight and BMI. The search was limited to human studies and had no language restrictions.
23
24 107 Reference lists of selected studies and reviews were also searched to identify additional articles.
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26 108

30 **Study selection**

31
32 110 We include RCTs that investigated the effect of pasta consumed alone or in the context of low-
33
34 111 GI dietary patterns that emphasized pasta in comparison with higher GI diets that did not include
35
36 112 pasta on body weight or other measures of global (BMI, body fat) or abdominal (waist
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38 113 circumference, waist-to-hip ratio, sagittal abdominal diameter, or visceral adipose tissue assessed
39
40 114 by imaging modalities) adiposity in participants of all health backgrounds. Trials were excluded
41
42 115 if they had diet duration of <3 weeks, did not intend to use a calorie- and macronutrient-matched
43
44 116 comparator arm that was higher in GI; included pregnant or breast-feeding women or children; or
45
46 117 did not provide suitable end-point data. When multiple publications existed for the same study,
47
48 118 the article with the most information was included (n=6). Published abstracts were not included.
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120 **Data extraction**

121 Two reviewers (LC, CB) assessed the titles and abstracts of all identified studies and
122 independently reviewed and extracted relevant data from each report, including study design,
123 blinding, sample size, participant characteristics, follow-up duration, identification of pasta in the
124 low-GI diet only, comparator diet, macronutrient profile, funding source, and outcome data. The
125 primary outcome was body weight, and secondary outcomes included markers of global (BMI,
126 body fat) and abdominal (waist circumference, waist-to-hip ratio, sagittal abdominal diameter, or
127 visceral adipose tissue assessed by imaging modalities) adiposity. Mean±SD differences between
128 test and control arms were extracted for each outcome.

129 In those trials where the data were included in figures and not provided numerically, we used the
130 software program Plot Digitizer (<http://plotdigitizer.sourceforge.net/>) to extract the data.

131 Additional information was requested from the authors of all included trials. Disagreement were
132 resolved by consensus or where necessary by a third author (SBM).

133

134 **Risk of bias assessment**

135 Risk of bias for each individual study was assessed using the Cochrane Risk of Bias tool¹⁹. The
136 level of bias was evaluated for sequence generation, allocation concealment, blinding,
137 incomplete outcome data, and selective reporting and determined overall as either low (proper
138 methods taken to reduce bias), high (improper methods creating bias), or unclear (insufficient
139 information provided to determine the bias level).

140

141 **Statistical analysis**

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3 142 Baseline, end-of-study, and between-treatment differences in body weight, BMI, waist
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5 143 circumference, body fat, waist-to-hip ratio, sagittal abdominal diameter or visceral adipose tissue
6
7 144 assessed by imaging modalities were recorded as means±SDs. If not provided, between-
8
9 145 treatment differences in change-from-baseline or end differences were calculated by subtracting
10
11 146 means and variance measures such as SEs were imputed with the use of published formulas¹⁹.
12
13 147 Missing SDs were imputed with the use of the pooled SD from other studies included in the
14
15 148 analysis¹⁹.
16
17 149 Data analyses were conducted using Review Manager version 5.3 (RevMan) (Copenhagen,
18
19 150 Denmark: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) for primary
20
21 151 analyses and Stata version 13 (College Station, TX: StataCorp LP) for subgroup analyses. A
22
23 152 generic inverse-variance method with random-effects models was used to calculate pooled mean
24
25 153 differences and 95% confidence intervals (CIs). Random-effects models were used even in the
26
27 154 absence of statistically significant inter-study heterogeneity, as they yield more conservative
28
29 155 summary effect estimates in the presence of residual heterogeneity. Change-from-baseline
30
31 156 differences were preferred over end differences and paired analyses were applied to all crossover
32
33 157 trials with the use of a within-individual correlation coefficient between treatments of 0.5 as
34
35 158 described by Elbourne et al.²¹
36
37 159 Inter-study heterogeneity was assessed by the Cochran Q statistic, where $P < 0.10$ was considered
38
39 160 statistically significant, and quantified by the I^2 statistic, where $I^2 \geq 50\%$ indicates substantial
40
41 161 heterogeneity¹⁹. Sensitivity analysis were performed which included the removal of each single
42
43 162 study from the meta-analyses one at a time and recalculation of the summary effect. An
44
45 163 influential outlier was considered a study whose removal changed the magnitude of the pooled
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47 164 effect by $>10\%$. Sensitivity analysis were also conducted using different correlation coefficient
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3 165 values for crossover trials (0.25 and 0.75) to test for the robustness of the effect size, conducting
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5 166 analyses using fixed effects models and restricting analyses to those trials for which pasta intake
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8 167 could be quantified.

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10 168 If ≥ 10 trial comparisons were available, then sources of heterogeneity were explored by
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12 169 subgroup analyses. A priori categorical subgroups analyses were assessed by meta-regression
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14 170 analyses. These included patient type (normal body weight, overweight or obese [average
15
16 171 baseline BMI $>27\text{kg/m}^2$]), diabetes, coronary heart disease), follow-up (<24 -weeks, ≥ 24 weeks),
17
18 172 baseline BMI (BMI ≤ 30 , $>30\text{kg/m}^2$), design (parallel, crossover), energy balance (negative on
19
20 173 both arms [weight loss diets], neutral on both arms [weight maintaining diets]) and dose of pasta
21
22 174 (based on the median). A priori categorical subgroup analyses also included the following dietary
23
24 175 factors: GI (absolute level [≤ 55 , >55 ; glucose scale], within-treatment change, between-treatment
25
26 176 change), fat intake (absolute level [$<30\%$, $\geq 30\%$ energy], within-treatment change, between-
27
28 177 treatment change), carbohydrate intake (absolute level [$<50\%$, $\geq 50\%$ energy], within-treatment
29
30 178 change, between-treatment change), protein intake (absolute level [$<20\%$, $\geq 20\%$ energy], within-
31
32 179 treatment change, between-treatment change), dietary fibre intake (absolute level [$<28\text{g/day}$,
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34 $\geq 28\text{g/day}$], within-treatment change, between-treatment change), and risk of bias. A priori
35
36 180 continuous meta-regression analyses were conducted on the absolute levels and within- and
37
38 181 between-treatment changes of these same dietary factors in the intervention arms of pasta in the
39
40 182 context of low-GI dietary patterns. Linear and non-linear pasta intake dose-response analyses
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42 183 were assessed by using continuous meta-regression analyses and spline curve modeling
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44 184 (MKSPLINE procedure), respectively. Publication bias was assessed by visual inspection of
45
46 185 funnel plots and the Egger²² and Begg²³ tests, when ≥ 10 trial comparisons were available. If
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3 187 publication bias was suspected, then adjustment for funnel plot asymmetry was done by imputing
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5 188 missing study data using the Duval and Tweedie trim and fill method ²⁴.
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10 190 **Grading the evidence**

11
12 191 The grading of recommendations assessment, development, and evaluation (GRADE) approach
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14 192 was used to assess the confidence in the pooled effect estimates by assessing the overall quality
15
16 193 and strength of the evidence ²⁵. Evidence was graded as high, moderate, low or very low quality.
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18 194 The included RCTs were graded as high quality evidence by default and downgraded based on
19
20 195 pre-specified criteria. Criteria to downgrade evidence included risk of bias (weight of studies
21
22 196 show risk of bias assessed by the Cochrane Risk of Bias tool), inconsistency (substantial
23
24 197 unexplained heterogeneity, $I^2 > 50\%$, $P < 0.01$), indirectness (presence of factors that limited the
25
26 198 generalizability of the results), imprecision (the 95% CI for effect estimates were wide or crossed
27
28 199 pre-specified minimally important differences [MIDs] for harm), and publication bias
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31 200 (significant evidence of small-study effects).
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38 202 **Patient involvement**

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41 203 No patients were directly involved in the development of the research question, selection of the
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43 204 outcome measures, design and implementation of the study, or interpretation of the results.
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48 206 **RESULTS**

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53 208 **Search results**

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209 **Figure 1** shows the flow of the literature. We identified 4876 reports of which 29 met eligibility
210 criteria. No reports were identified that assessed the effect of pasta alone, while 29 reports
211 (including 32 trial comparisons involving 2448 participants) were identified that assessed the
212 effect of pasta in the context of low-GI dietary patterns on any adiposity outcome in adults²⁶⁻⁵⁴.
213 Of the 32 trial comparisons that assessed the effect of pasta in the context of a low-GI dietary
214 pattern, there were 32 trial comparisons for body weight, 18 trial comparisons for BMI<sup>27,28,31-
215 33,35,36,39-41,43-46,48,49,52,53</sup>, 18 trial comparisons for waist circumference^{27,28,31,33,34,36,38-40,42,44-47,52,53},
216 10 trial comparisons for body fat^{27,28,31-33,36,38,41,43,53}, 6 trial comparisons for waist-to-hip
217 ratio^{31,39,40,44,45,52}, and 3 trial comparisons for sagittal abdominal diameter^{34,39}. There was only
218 one trial comparison identified³⁵ for visceral adipose tissue assessed by imaging modalities, thus
219 a meta-analysis could not be undertaken for this outcome.

221 **Trial characteristics**

222 **Table 1** and **Supplemental Table S3** show the characteristics of all included trials of the effect
223 of pasta in the context of low-GI dietary patterns. The majority of trials had a parallel design
224 (26/32) with a median follow-up of 12 weeks (IQR: 9–21 weeks) and a median number of
225 participants per trial of 43 (IQR: 21–112). Most participants were middle aged (median age: 50
226 y; IQR: 40-58 y) men and women (median ratio of men to women: 0.4:1 in available trials). The
227 median baseline BMI across studies was 30.4kg/m² (IQR: 28.2–32.0). Regarding metabolic
228 phenotype, 21 (66%) trials included participants who were overweight or obese (had a baseline
229 BMI \geq 27kg/m²), 10 (31%) had diabetes and one trial (3%) with coronary heart disease (CHD).
230 We did not retrieve any trials where participants had a normal BMI at baseline (\leq 25kg/m²),

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3 231 although 6 trials did not include BMI >25 kg/m² as part of criteria, the average baseline BMI was
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5 232 ≥27 kg/m², therefore categorized as overweight.
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10 234 **Risk of bias**

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12 235 **Supplemental Figures S1 and S2** show the individual Cochrane Risk of Bias tool assessments
13
14 236 for each of the included trials of the effect of pasta in the context of low-GI dietary patterns. No
15
16 237 serious risk of bias was detected.
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21 239 **Effect of Pasta in the Context of Low-GI dietary patterns and Body Weight**

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23 240 **Figure 2** shows the effect of pasta in the context of low-GI dietary patterns on the primary
24
25 241 outcome body weight. Pooled analyses showed pasta in the context of low-GI dietary patterns
26
27 242 had the effect of reducing body weight by -0.63 kg (95% CI:-0.84, -0.42 kg; P<0.001) compared
28
29 243 with higher GI control diets with no evidence of heterogeneity (I²=0%, P-heterogeneity=0.51).
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34 245 **Effect of Pasta in the Context of Low-GI dietary patterns on Markers of Global Adiposity**

35
36 246 **Figure 3 and Supplemental Figure S3-S4** show the effect of pasta in the context of low-GI
37
38 247 dietary patterns on markers of global adiposity. Pooled analyses showed that pasta in the context
39
40 248 of low-GI dietary patterns had the effect of reducing BMI by -0.26kg/m² (n=18 trials; MD=-
41
42 249 0.26kg/m²; 95% CI:-0.36, -0.16 kg/m²; P<0.001) compared with higher GI control diets with no
43
44 250 evidence of heterogeneity (I²=0%, P-heterogeneity=0.90). There was no effect on body fat (n=10
45
46 251 trials; MD=-0.01%, 95% CI:-0.58, 0.56%; P=0.98) with evidence of substantial heterogeneity
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48 252 (I²=65%, P<0.01).
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3 254 **Effect of Pasta in the Context of Low-GI dietary patterns on Markers of Abdominal**
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5 255 **Adiposity**

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7 256 **Figure 3 and Supplemental Figures S5-S7** show the pooled estimates for the markers of
8
9
10 257 abdominal adiposity. Pooled analyses did not show a significant effect of pasta in the context of
11
12 258 low-GI dietary patterns compared with higher-GI control diets on waist circumference (n=18
13
14 259 trials; MD=-0.46cm, 95% CI:-1.05, 0.14cm; P=0.13), waist-to-hip ratio (n=6 trials; MD=-0.00,
15
16 260 95% CI:-0.01, 0.00; P=0.27), or sagittal abdominal diameter (n=3 trials, MD=-0.09cm, 95% CI:-
17
18 261 0.34, 0.16cm; P=0.48) There was only evidence of substantial heterogeneity in the analyses for
19
20 262 waist circumference ($I^2=62%$, P-heterogeneity<0.01).
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26 264 **Sensitivity analyses**

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28 265 We conducted four sets of sensitivity analyses (**Supplemental Tables S4-5, Supplemental**
29
30 266 **Figures S8-9**). The systematic removal of each trial did not modify the direction or significance
31
32 267 of the effect estimates or the evidence of heterogeneity for any of the outcomes with the
33
34 268 exception of waist circumference (**Supplemental Table S4**). In the sensitivity analysis for waist
35
36 269 circumference, two studies were influential outliers in that their removal altered the magnitude of
37
38 270 the pooled effect in the remaining studies by >10%, where the removal of the studies of
39
40 271 McMillan-Price et al. (high protein comparison)⁴² and Jenkins et al.⁴⁴ rendered the results for
41
42 272 waist circumference statistically significant (MD= -0.62cm; 95% CI: -1.19, -0.05; P=0.03) and
43
44 273 (MD= -0.61cm; 95% CI: -1.18, -0.04; P=0.04), respectively; forest plots not shown).
45
46 274 Heterogeneity remained significant in both cases ($I^2= 55%$, P-heterogeneity <0.01 and $I^2=50%$,
47
48 275 P-heterogeneity= 0.01, respectively). Sensitivity analyses using correlation coefficients of 0.25
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50 276 and 0.75 for paired analyses of crossover trials also did not modify the results (**Supplemental**
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3 277 **Table S5**). In the sensitivity analyses where fixed effects models were applied (**Supplemental**
4
5 278 **Figure S8**), the direction, magnitude and significance of the pooled estimates were very similar
6
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8 279 to those produced by the random effects models with the exception of the sensitivity analysis for
9
10 280 waist circumference which was significant (MD= -0.62; 95% CI: -0.93, -0.32; P<0.001). Finally,
11
12 281 restricting analyses to the 11 trials for which pasta intake could be quantified (median pasta
13
14 282 intake, 3.33 servings/week [range, 1.75 – 7 servings/week]) showed a similar reduction in body
15
16 283 weight (MD= -0.70 kg; 95% CI:-1.10, -0.29 kg; P<0.001) when pasta was consumed in the
17
18 284 context of low-GI dietary patterns compared with the higher GI control arms without evidence of
19
20 285 heterogeneity ($I^2=0\%$, P-heterogeneity=0.68) (**Supplemental Figure S9**).
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26 287 **Subgroup analyses**

28 288 We were only able to conduct a priori categorical and continuous subgroup analyses for body
29
30 289 weight, BMI, body fat and waist circumference. Subgroup analyses for waist-to-hip ratio and
31
32 290 sagittal abdominal diameter could not be assessed, owing to <10 trial comparisons in each case.
33
34 291 **Supplemental Figures S10-S12** show the categorical a priori subgroup analyses for body
35
36 292 weight. There was no evidence of significant effect modification in any of the subgroup analyses
37
38 293 for body weight, including no effect modification of follow-up when comparing studies less than
39
40 294 24 weeks duration to those greater than or equal to 24 weeks (-0.63kg vs -0.57kg, respectively)
41
42 295 (**Supplemental Figure S10**). Neither was there evidence of significant effect modification in any
43
44 296 of the subgroup analyses for BMI, body fat or waist circumference (**Supplemental Figures S13-**
45
46 297 **20**).
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3 299 **Supplemental Table S6** and **Supplemental Figures S21-22** show the continuous subgroup
4
5 300 analyses for body weight. There was evidence of significant effect modification by carbohydrate
6
7 301 and protein intake, where an increase in carbohydrate intake in the intervention group in which
8
9 302 pasta was consumed in the context of low-GI dietary patterns was associated with weight loss
10
11 303 ($\beta = -0.07$, 95% CI: -0.12, -0.01, $I^2 = 0.00\%$, $P = 0.02$), and an increase in protein intake in the
12
13 304 intervention group in which pasta was consumed in the context of low-GI dietary patterns was
14
15 305 associated with weight gain ($\beta = 0.15$, 95% CI: 0.03, 0.27, $I^2 = 0.00\%$, $P = 0.02$). None of the other
16
17 306 continuous subgroup analyses were significant. There was no evidence of significant effect
18
19 307 modification in any of the continuous subgroup analyses for BMI (**Supplemental Table S7**). For
20
21 308 body fat, there was evidence of significant effect modification in the continuous meta-regression
22
23 309 subgroup analysis of difference in GI between intervention and control groups, where greater
24
25 310 difference in GI between the groups was associated with greater reduction in body fat in the
26
27 311 intervention group ($\beta = -0.09$, 95% CI: -0.15, -0.03, $I^2 = 19.39\%$, $P = 0.01$) (**Supplemental Table**
28
29 312 **S8**). None of the other continuous subgroup analyses were significant. For waist circumference,
30
31 313 there was evidence of significant effect modification in the continuous meta-regression subgroup
32
33 314 analysis of absolute carbohydrate level and absolute protein level, where greater carbohydrate
34
35 315 level in the intervention group in which pasta was consumed in the context of low-GI dietary
36
37 316 patterns was associated with greater loss in waist circumference ($\beta = -0.11$, 95% CI: -0.19, -0.04,
38
39 317 $I^2 = 27.06\%$, $P < 0.01$) and a lower protein level in the intervention group in which pasta was
40
41 318 consumed in the context of low-GI dietary patterns was associated with an increase in waist
42
43 319 circumference ($\beta = 0.20$, 95% CI: 0.01, 0.38, $I^2 = 43.92\%$, $P = 0.04$) (**Supplemental Table S9**).
44
45 320 None of the other continuous subgroup analyses were significant.
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3 322 **Dose-response analyses**
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5 323 **Supplemental Tables S6 and S10** and **Supplemental Figure S23** show the dose-response
6
7 324 analysis for the 11 trials for which pasta intake could be quantified. No evidence of a linear dose
8
9 325 response was seen for pasta intake by meta-regression analyses (**Supplemental Table S6**).
10
11 326 There was also no evidence of a non-linear dose response by MKSPLINE (p=0.85)
12
13 327 (**Supplemental Figure S23**) or piecewise linear meta-regression analyses (**Supplemental Table**
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15 328 **S10**).
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22 330 **Publication Bias**
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24 331 **Supplemental Figures S24-S27** shows the funnel plots for body weight, BMI, body fat and
25
26 332 waist circumference. There was no evidence of funnel-plot asymmetry. Formal testing with the
27
28 333 Egger and Begg tests did not show evidence of small-study effects (P>0.05 for both). Publication
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30 334 bias was not assessed for waist-to-hip ratio and sagittal abdominal diameter, owing to <10 trial
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32 335 comparisons.
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38 337 **GRADE Assessment**
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40 338 **Supplemental Table S11** shows a summary of the GRADE assessments for the effect of pasta in
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42 339 the context of low-GI dietary patterns on body weight and measures of adiposity. The evidence
43
44 340 was graded as moderate for body weight, BMI, waist-to-hip ratio and sagittal abdominal
45
46 341 diameter owing to downgrades for indirectness and low for waist circumference and body fat,
47
48 342 owing to downgrades for indirectness and inconsistency ($I^2=59%$, P-heterogeneity<0.001;
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50 343 $I^2=66%$, P-heterogeneity<0.01, respectively).
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DISCUSSION

The present systematic review and meta-analysis quantified the effect of pasta alone and pasta in the context of low-GI dietary patterns on body weight and other markers of adiposity. We identified no trial comparisons for the effect of pasta alone and 32 trial comparisons involving 2448 participants who were predominantly middle-aged and overweight or obese for the effect of pasta in the context of low-GI dietary patterns. The primary pooled analysis demonstrated that pasta in the context of low-GI dietary patterns did not contribute to weight gain, resulting in a significant weight loss of -0.63 kg when compared to diets higher in GI over a median follow-up of 12 weeks. The lack of harm was reflected in the established clinical secondary outcome measures of global (BMI and body fat) and abdominal adiposity (waist circumference, waist-to-hip ratio and sagittal abdominal diameter). These findings were robust across subgroups. The findings did not differ by metabolic phenotype in those who were overweight or obese or had diabetes, which is noteworthy since these are populations who would benefit from weight management strategies. There was also no effect modification by the energy balance of the design such that the weight loss was seen even under conditions of neutral energy balance (in which participants were instructed to consume dietary advice ad libitum), suggesting that encouragement of the consumption of pasta in the context of a low-GI dietary patterns does not cause harm and may even lead to spontaneous weight loss. There was also no effect modification by follow-up either in continuous meta-regression or categorical, where the 24 trials with <24weeks follow-up had a weight reduction similar to those 8 trials with ≥ 24 weeks follow-up (-0.63kg vs -0.57kg, respectively). This is of relevance since many dietary studies are successful in demonstrating weight loss in the short term but not over the long term.

368 **Findings in the context of existing studies**

369 We are not aware of any RCTs directly assessing the effect of pasta intake on health
370 parameters including body weight. Our findings, however, agree with earlier systematic reviews
371 and meta-analyses of RCTs of the effect of low-GI dietary patterns irrespective of pasta intake
372 on body weight and adiposity. The systematic review and meta-analysis by Thomas et al. in 2007
373 found a significant -1.1kg weight loss and -1.3kg/m² reduction in BMI favouring low-GI or
374 glycemic load (GL) diets compared to control diets in 6 RCTs of 5 weeks to 6 months in duration
375 in overweight or obese individuals¹³. Another systematic review and meta-analysis by
376 Schwingshackl et al. in 2013 found a -0.62kg weight loss favouring low-GI/GL diets compared
377 to higher GI/GL diets in 14 RCTs with greater than 6 months duration in overweight individuals
378 (BMI>25kg/m²)¹⁴.

379
380 Our findings also agree with trials in which pasta was emphasized in the context of other healthy
381 dietary patterns. One trial done in children in Spain given Mediterranean dietary advice which
382 included increasing the intake of pasta found that approximately 11.3% of the participants in the
383 Mediterranean diet group who were classified as overweight and obese changed their weight
384 status to normal weight compared to only approximately 2.6% of the participants in the control
385 group⁵⁵.

386
387 Other lines of evidence from observational studies have demonstrated benefits of pasta
388 consumption on body weight and adiposity. Pasta intake was recently assessed in the Moli-sani
389 study and the Italian Nutrition & Health Survey (INHES), a cross-sectional study of over
390 20,000 Italians from all over Italy⁵⁶. The study demonstrated that higher pasta consumption was

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3 391 associated with lower BMI, waist circumference and waist-to-hip ratio and with a lower
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5 392 prevalence of overweight and obesity⁵⁶. Furthermore, greater pasta intake was associated with
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7 393 better adherence to the Mediterranean diet, a dietary pattern which has a demonstrated
8
9 394 cardiovascular benefit⁵⁷. Similar associations between greater pasta intake and lower body
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11 395 weight have also been observed in prospective U.S. cohorts⁵⁸. A pooled analysis of the 3
12
13 396 Harvard cohorts also showed that higher GI diets (which would preclude pasta) were associated
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15 397 with weight gain⁵⁹.
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21 399 Although the product form of pasta can vary widely, including in shape (e.g. macaroni, spaghetti,
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23 400 linguine), ingredients (e.g. type of wheat, egg content), and processing technique (e.g. drying
24
25 401 temperature), studies have demonstrated that when comparing pastas varying in these
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27 402 parameters, despite slight variations in glycemic response among pastas, glycemic responses are
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29 403 still lower compared to a control, e.g. white bread^{60,61}. One concern of the choice of pasta as a
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31 404 carbohydrate food is that it is a refined food low in fibre. Although there are whole grain pasta
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33 405 options available, studies have demonstrated that fiber added to pasta, does not significantly
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35 406 affect the glucose or insulin response, the secretion of gut hormones or satiety^{62,63}. Furthermore,
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37 407 pasta has a similar glycemic response compared to many fiber-rich carbohydrates, including
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39 408 barley, legumes and steel cut oats, and still a lower glycemic response compared to other fiber-
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41 409 rich foods including whole wheat bread, breakfast cereals like bran flakes and potatoes with
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43 410 skin⁶⁴.
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51 412 The mechanism by which pasta in the context of low-GI dietary patterns lead to weight loss even
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53 413 under conditions of ad libitum dietary advice is unclear. Lower GI diets may result in greater
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3 414 body weight reduction compared to higher GI diets because lower GI foods may be more
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5 415 satiating⁶⁵ and have been shown to delay hunger and decrease subsequent energy intake¹³. Low-
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7 416 GI dietary patterns are also characterized by high fiber content^{64,66} which may also contribute to
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10 417 improvements in satiety and hunger¹⁷. Furthermore, studies which have compared ad libitum
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12 418 low-GI dietary patterns to standard energy-restricted low-fat diets, demonstrated equivalency or
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14 419 better weight loss when following the low-GI diet, despite the fact that they could eat as much as
15
16 420 they desired^{13,67}. Thus, voluntary energy intake may be lower after low-GI meals, as has been
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18 421 previously demonstrated⁶⁸.

422

423 **Strengths and limitations**

424 The strengths of the present systematic review and meta-analysis include that it is
425 comprehensive, includes RCTs which protects against bias and uses GRADE to evaluate the
426 quality of evidence. Additionally, a large number of trials were identified (32 trials) for the
427 primary outcome of body weight, the median follow-up period was 12 weeks which allows for
428 the assessment of a moderate duration of intervention, none of the trials were rated as having a
429 serious risk of bias, and there was no evidence of publication bias.

430

431 There are several limitations. First, the present systematic review and meta-analysis showed
432 evidence of inconsistency in the treatment estimates across trials for some of the outcomes
433 assessed. There was evidence of unexplained heterogeneity in waist circumference ($I^2=62\%$) and
434 in body fat ($I^2=65\%$). Although the inconsistency in these outcomes may have related to
435 measurement error⁶⁹ in the different techniques for measuring waist circumference and body fat,
436 we were unable to conduct sensitivity or subgroup analyses to explore this source of

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3 437 heterogeneity. Second, there was evidence of indirectness. Most of the available trials did not
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5 438 quantify the amount of pasta consumed in the context of the low-GI dietary patterns. Although
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7 439 sensitivity analyses in which analyses were restricted to the 11 trials that did quantify (providing
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9 440 a median 3.33 servings/week) pasta intake did not meaningfully alter our estimates (-0.70kg
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11 441 versus -0.63kg), it is difficult to quantify the effect of pasta in these diets. There is also the
12
13 442 question of translation to other background diets. Whether the observed effect of pasta in the
14
15 443 context of low-GI dietary patterns will hold in the context of other healthy dietary patterns, such
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17 444 as Mediterranean and Vegetarian dietary patterns, is unclear. Although there is no biological
18
19 445 reason to doubt that the findings would hold, there is a lack of direct evidence to support this
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21 446 conclusion. If the question had been asked from the perspective of benefit as opposed to that of
22
23 447 harm, then the relatively short duration of the included trials may be another reason to
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25 448 downgrade for indirectness. In the absence of long-term trials (>1 year diet duration), it is
26
27 449 difficult to conclude with certainty that the observed lack of harm implies an actual sustainable
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29 450 benefit. Finally, there was some evidence of imprecision for benefit but not harm. Whereas the
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31 451 95% CI of the pooled estimates did not overlap with our pre-specified MID for harm (that is,
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33 452 they did not contain evidence for harm) and so were not downgraded for imprecision, the upper
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35 453 bound of the 95% CI would overlap with the lower bound of the same MID to assess the
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37 454 precision of the evidence for benefit for some outcomes.
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47 456 Balancing these strengths and limitations, GRADE assessed the overall quality and strength of
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49 457 the available evidence of the effect of pasta in the context of low-GI dietary patterns as moderate
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51 458 for the primary outcome of body weight and the secondary outcomes of BMI, waist-to-hip ratio
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53 459 and sagittal abdominal diameter owing to downgrades for indirectness. The evidence was
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3 460 assessed as low for the other secondary outcomes of body fat and waist circumference owing to
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5 461 downgrades for indirectness and inconsistency.
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10 463 **Implications**

12 464 These results are important considering the negative messages directed at the public regarding
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14 465 carbohydrates, which is influencing their food choices, as is evident in recent reductions in
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16 466 carbohydrate intake⁷⁰⁻⁷², and in particular reductions in pasta consumption^{70,73-76}. Contrary to
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19 467 these concerns, the available evidence shows that when pasta is consumed in the context of low-
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21 468 GI dietary patterns that there is not weight gain but rather marginally clinically significant weight
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23 469 loss (>0.5kg)⁷⁷.
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28 471 Although we were able to approximate the amount of pasta consumed in one third of included
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30 472 trials, it is unclear what the effect of pasta would be in the context of other dietary patterns. Low-
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32 473 GI dietary patterns, however, shares many similarities with a Mediterranean diet, which
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34 474 emphasizes many low-GI foods and has demonstrated a CVD benefit⁵⁷.
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39 476 Current clinical practice guidelines already suggest the replacement of high GI foods with low-
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41 477 GI foods for improvement of glycemic control and cardiovascular risk factors^{78,79}. The present
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43 478 evidence means that pasta may be highlighted as an important example of a low-GI food which
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45 479 can contribute to a low-GI dietary pattern, a pattern which in turn may potentially improve
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47 480 cardio-metabolic risk without an adverse effect on weight control.
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54 **CONCLUSIONS**

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3 483 In conclusion, pasta consumed in the context of low-GI dietary patterns does not have an adverse
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5 484 effect on body weight and adiposity outcomes of importance in the prevention and management
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7 485 of overweight and obesity. The results are generalizable in the context of a high carbohydrate
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9 486 diet composed of low-GI foods with or without the intention of weight loss in middle-aged
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11 487 individuals who are overweight or obese or have diabetes. Although the clinical significance of
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13 488 the observed weight loss is debatable, this finding increases our confidence that pasta in the
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15 489 context of low-GI dietary patterns does not result in weight gain. Further research may change
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17 490 our confidence in the estimates for our primary outcome body weight and several key secondary
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19 491 outcomes including BMI and two measures of abdominal adiposity, waist-to-hip ratio and
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21 492 sagittal abdominal diameter. More research, however, is needed, to improve our estimates for
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23 493 the secondary outcomes, body fat and waist circumference and assess whether our findings
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25 494 extend to related cardio-metabolic outcomes. There is also a need for more randomized trials of
26
27 495 >1 year diet duration to clarify whether the lack of harm for pasta in the context of low-GI
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29 496 dietary patterns will translate into meaningful long-term benefits. Other randomized trials should
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31 497 focus on whether pasta will have similar effects in the context of other healthy dietary patterns
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33 498 such as a Mediterranean diet.
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3 501 **Figure Legend**
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5 502 **Figure 1:** Literature Search
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7 503 **Figure 2:** Forest plot of randomized controlled trials investigating the effects of pasta in the
8 504 context of low-GI dietary patterns on body weight (kg). n = 2448. Data are expressed as mean
9 505 differences represented by a square and 95% CIs by the line through the square. 95% CIs
10 506 exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are
11 507 represented by diamonds and were estimated with the use of generic inverse variance random
12 508 effects models. Between-study heterogeneity was detected with the use of the Cochran's Q
13 509 statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where
14 510 $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable
15 511 heterogeneity.

16 512 CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic
17 513 index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty
18 514 acids; Pro, protein.
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22

23 516 **Figure 3:** Plot of pooled effect estimates from randomized controlled trials investigating the
24 517 effects of pasta in the context of low-GI dietary patterns on global and abdominal markers of
25 518 adiposity. Pooled effect estimates are represented by diamonds and were estimated with the use
26 519 of generic inverse variance random effects models. Between-study heterogeneity was detected
27 520 with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the
28 521 use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and
29 522 $\geq 75\%$ considerable heterogeneity.

30 523 BMI; body mass index; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic
31 524 index; LGI, low glycemic index diet.
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19

20 **534 Data Sharing**
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23 535 No additional data available.
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26 536
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28 **537 Exclusive License**
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44
45 660 Society for Nutrition (ASN), FoodMinds LLC, Memac Ogilvy & Mather LLC, Pulse Canada,
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47 661 Pepsico, BCFN Foundation, The Ginger Network LLC, and Dietitians of Canada. He has ad hoc
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3 662 consulting arrangements with Winston & Strawn LLP, Perkins Coie LLP, and Tate & Lyle. He is
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5 663 a member of the European Fruit Juice Association Scientific Expert Panel. He is on Clinical
6
7 664 Practice Guidelines Expert Committees of the Canadian Diabetes Association (CDA) European
8
9 665 Association for the study of Diabetes (EASD), and Canadian Cardiovascular Society (CCS), as
10
11 666 well as an expert writing panel of the American Society for Nutrition (ASN). He serves as an
12
13 667 unpaid scientific advisor for the Food, Nutrition, and Safety Program (FNSP) and the Technical
14
15 668 Committee on Carbohydrates of the International Life Science Institute (ILSI) North America.
16
17 669 He is a member of the International Carbohydrate Quality Consortium (ICQC), Executive Board
18
19 670 Member of the Diabetes and Nutrition Study Group (DNSG) of the EASD, and Director of the
20
21 671 Toronto 3D Knowledge Synthesis and Clinical Trials foundation. His wife is an employee of
22
23 672 Unilever Canada. No competing interests were declared by **CR Braunstein, S Blanco Mejia,**
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25 673 **and LA Leiter.**
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873 **Table 1:** Summary of trial characteristics

Trial Characteristics*	ALL	Neutral Energy Balance	Negative Energy Balance
Trial Number (n)	32	23	9
Trial Size (total, range)	2448 (8 - 250)	1989 (8 - 250)	459 (13 - 123)
Male: Female^a (%)	40:60	47:53	27:73
Age (years)	50 (40 - 58)	52.0 (42.1 – 59.5)	49.5 (34.2 – 53.0)
Metabolic Phenotype (OW/OB:DM:CHD) (%)	66:31:3	57:39:4	89:11:0
Setting (IP:OP) (%)	3:97	4:96	0:100
Baseline Body Weight (kg)^b	85.5 (80.0 - 91.9)	84.1 (79.5 – 87.5)	92.5 (86.1 – 93.9)
Baseline BMI (kg/m²)^c	30.4 (28.2 - 32.0)	29.5 (27.4 – 31.4)	31.7 (30.1 – 32.9)
Study Design (C:P) (%)	19:81	26:74	0:100
Dose Pasta (servings/week)^d	3.3 (2.3 - 3.5)	3.4 (2.9 – 4.1)	2.3 (2.3-3.5)
GI in Pasta/LGI group	49.0 (44.0 - 55.1)	46.5 (49.9 – 55.5)	44.0 (42.3 - 49.4)
GI in Higher GI group	62.5 (61.6 - 63.2)	63.3 (60.1 – 64.4)	61.0 (59.2 – 66.6)
Calorie reduction in Pasta/LGI group (kcal)^e	-179 (-90 - -448)	-165 (-74 - -313)	-447 (-134 - -594)
Calorie reduction in Higher GI group (kcal)^e	-181 (-93 - -401)	-160 (-40 - -248)	-470 (-172 - -561)
Feeding Control (Met:Supp:DA) (%)	6:44:50	4:48:48	11:33:56
Follow-Up Duration (Weeks)	12 (9-21)	12 (6-24)	12 (10 - 21)
Funding Sources (A:I:AI:NR) (%)	47:9:25:19	44:13:26:17	56:0:22:22

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875 * median (inter quartile range), unless otherwise indicated

876 ^a24/32 trials provided data on sex

877 ^b 30/32 trials reported baseline body weight

878 ^c 28/32 trials reported baseline BMI

879 ^d 11/32 trials provided data from which dose could be approximated

880 ^e 20/32 trials provided data from which to approximate changes in caloric intake

881 A, agency; AI, agency and industry; BMI, body mass index; C, crossover design; CHD, coronary
882 heart disease; DA, dietary advice; DM, diabetes; GI, glycemic index; I, industry; IP, inpatient;
883 LGI, low glycemic index; Met, metabolic; NR, not reported; OB, obese; OP, outpatient; OW,
884 overweight; P, parallel design; Suppl, supplemented/provision of certain food

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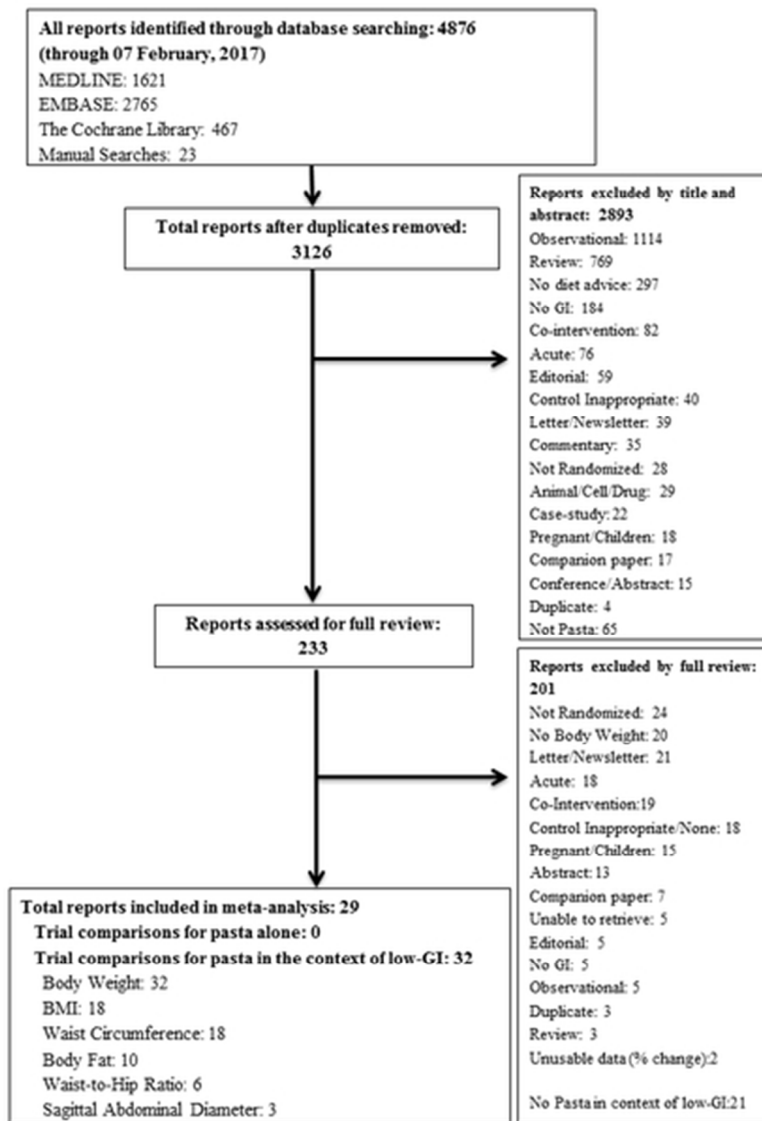


Figure 1: Literature Search

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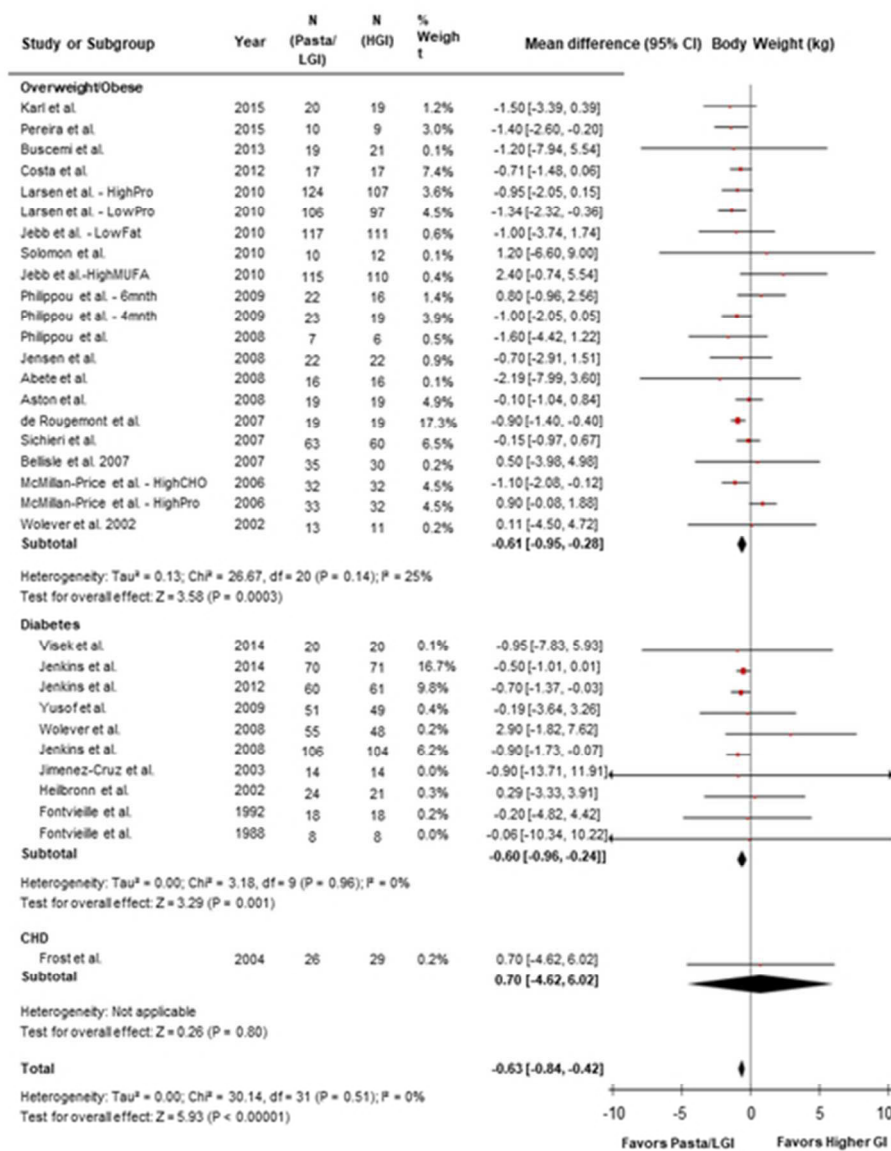


Figure 2: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg). n = 2448. Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids; Pro, protein.

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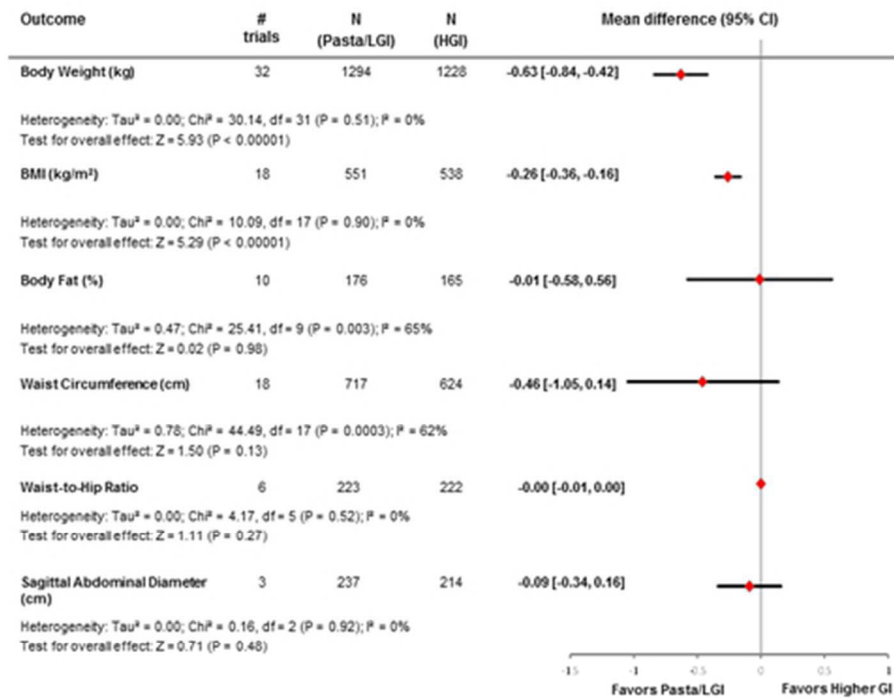


Figure 3: Plot of pooled effect estimates from randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on global and abdominal markers of adiposity. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran’s Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I² statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity. BMI; body mass index; CI, confidence interval; HGI, higher glycemic index diet; LGI, low glycemic index diet.

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Online Supplemental Information

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Supplemental Tables

Supplemental Table S1: Search strategy for studies assessing the effect of pasta in the context of low-GI dietary patterns on body weight in randomized controlled trials

Database	Search Period	Search Terms
Medline	1946 to February 07, 2017	<ol style="list-style-type: none"> 1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycaemic index.tw. 8. glycemic index.tw. 9. glycaemic ind*.tw. 10. glycemic ind*.tw. 11. glycemic load*.tw. 12. glycaemic load*.tw. 13. glycemic index/ 14. body mass index/ 15. body mass index.tw. 16. BMI.tw. 17. overweight.tw. 18. weight*.tw. 19. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 20. 14 or 15 or 16 or 17 or 18 21. 19 and 20 22. limit 21 to animals 23. 21 not 22
Embase	1946 to February 07, 2017	<ol style="list-style-type: none"> 1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycaemic index.tw. 8. glycemic index.tw. 9. glycaemic ind*.tw. 10. glycemic ind*.tw. 11. glycemic load*.tw. 12. glycaemic load*.tw. 13. glycemic index/ 14. body mass index/ 15. body mass index.tw. 16. BMI.tw.

		<p>17. overweight.tw. 18. weight*.tw. 19. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 20. 14 or 15 or 16 or 17 or 18 21. 19 and 20 22. limit 21 to animals 23. 21 not 22</p>
The Cochrane Library	1946 to February 07, 2017	<p>1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycemic index/ 8. glycaemic ind*.tw. 9. glycemic ind*.tw. 10. glycemic load*.tw. 11. glycaemic load*.tw. 12. exp body weight/ 13. body weight*.tw. 14. BMI.tw. 15. body mass index/ 16. body mass index.tw. 17. weight*.tw. 18. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 19. 12 or 13 or 14 or 15 or 16 or 17 20. 18 and 19 21. limit 20 to animals 22. 20 not 21</p>

Supplemental Table S2: PICO framework of the search strategy

PICO framework^a defined in the present systematic review and meta-analysis			
Participants	Interventions	Comparators	Outcomes
Adult men and women excluding pregnant or breastfeeding women	Low glycemic index interventions where pasta is included as part of the intervention	Higher glycemic index diets where pasta is not included as part of the intervention	Body weight Body mass index (BMI) Body Fat (%) Waist circumference Waist-to-hip ratio

a Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA and PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Systematic Reviews 2015; 4:1. <https://doi.org/10.1186/2046-4053-4-1>

Supplement Table S3a: Trial characteristics

Overweight/Obese Trials														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Karl et al. 2015 †††	39 (19M:20F)**	OB, OP					2.33	USA	P	Negative+ Neutral	17		CR to 2/3kcal; Metabolic	Agency
Low GI	20		56 (5)*	92.9 (13.6)*	32.3 (3.4)*	42:133						68:15:16		
Higher GI	19		56 (5)*	94 (9.7)*	33.4 (2.6)*	61:201						70:16:14		
Pereira et al. 2015	19 (4M:15F)**	OW, IP/OP					NR	Brazil	P	Neutral	6.4		Ad libitum	Unknown
Low GI	10		28(5)	80.0(12.6)	29.9 (2.1)	41.2(2.2) ¥ **						48.3:16.1:32.8		
Higher GI	9		26(3)	79.1(12.2)	29.1 (2.0)	74.1(2.9) ¥ **						54.6:12.7:34.4		
Buscemi et al. 2013	40 (19M:21F)**	OW/OB, high CVD risk, OP					NR	Italy	P	Negative	12		CR to 20kcal/kg/d; Ad libitum	Unknown
Low GI	19		51 (8)	93.8 (17.3)	34.3 (6.6)	48.1: 138						56:18:26		
Higher GI	21		49 (8)	93.2 (14.4)	34.5 (5.1)	59.3: 174						57:16:27		
Costa et al. 2012	17 (7M:10F)	OW, IP/OP	25.4 (5.8)	84.1(16.3)	26.3(3.2)		NR	Brazil	C	Neutral	4		Ab libitum,2 meals+3 fruit/d provided	NR
Low GI						47.5(3.8)						58.6:13.9:25.5		
Higher GI						61.6(2.8)						55.4:14.2:30.3		
Jebb et al. 2010 - High MUFA	225**	OH, some CV risk factors, OP	~52		~28.5 ⁺		1.75	UK	P	Neutral	24		Ad Libitum, key foods provided	Agency, foods by industry
Low GI	115			83.7 (69.6-93.1)¶¶¶		~55.2						~44.6:16.4:35.7****		
Higher GI	110			80.5 (70.0-92.1)¶¶¶		~63.3						~44.9:15.3:35.6****		
Jebb et al. 2010 - Low Fat	250**	OH, some CV risk factors, OP	~52		~28.5 ⁺		3.5	UK	P	Neutral	24		Ad Libitum, key foods provided	Agency, foods by industry
Low GI	117			79.4 (70.1- 91.8)¶¶¶		~56.3						~51.5:14.2:26.1****		
Higher GI	111			80.7 (71.4- 91.4)¶¶¶		~64.4						~51.1:15.7:27.5****		
Larsen et al. 2010-High Pro	231**	OW/OB, OP			NR		NR	Europe	P	Neutral	26		Ad libitum	Agency
Low GI	124		42.1 (6.5)	88.5 (15.6)		~56.5: 108.9						~43:22:32		
Higher GI	107		42 (5.7)	89.5 (17.1)		~61.4: 113.1						~45:23:31		
Larsen et al. 2010 - Low Pro	203 **	OW/OB, OP			NR		NR	Europe	P	Neutral	26		Ad libitum	Agency
Low GI	106		42.2 (5.7)	88.4 (15.7)		~56.2: 121						~51:18:30		
Higher GI	97		42 (5.9)	86.6 (13.8)		~61.6: 137.9						~51:17:31		

Supplement Table S3b: Trial characteristics continued

Overweight/Obese Trials continued															
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source	
Solomon et al. 2010	22 (8M:14F)**	OB, Pre-T2DM, OP					7	USA	P	Neutral	12		Metabolic plus exercise program	Agency	
Low GI	10 (3M:7F)		67 (6)	97.4 (12.0)	34.9 (1.1)	39.8 (0.9)						54.7(0.3):28.3(0.3):17.0(0.3)			
Higher GI	12 (5M:7F)		64 (3)	94.7 (15.2)	34.1 (1.1)	80.0 (2.1)						55.6(0.7):27.8(0.7):16.6(0.3)			
Philippou et al. 2009- 6 mo	38**	≥1 CHD risk factors, OP	(35-65) ¶				NR	UK	P	Negative (for all but n=2)	24		500kcal CR; Ad libitum	Agency	
Low GI	22			91.3(14.8)***	29.1 (3.6)***	50.6 (4.6): 114.4(31.5)									
Higher GI	16			97.5(16.4)***	30.5 (3.5)***	63.2(5.6): 175.0(45.6)									
Philippou et al. 2009- 4 mo	42**	OW, OP	(18-65)¶				NR	UK	P	Neutral	16		Ad libitum	Unknown	
Low GI	23			87.2 (15.3)	32.5 (4.8)	49.7(5.7):89.7(27.5)						47.6(6.7):19.5(4.2):31.8(5.8)			
Higher GI	19			83.6 (13.4)	31.3 (4.8)	63.7(9.4):136.8(56.3)						48.9(7):19.3(4.9):30.9(9)			
Abete et al. 2008	32 (18M:14F)	OB, OP	36(7)				2.33	Spain	P	Negative	8		30% CR; Ad libitum, 3-day menus	Agency	
Low GI	16			94.3(16.1)	32.8 (4.3)	(40-45)¶						50.2 (1.8):18.3(1.6):31.5(1.6)			
Higher GI	16			94.4(13.1)	32.2 (4.4)	(60-65)¶						47.8(6.8):19.6(5.6):32.6(4.3)			
Aston et al. 2008	19 (0M:19F)**	OW/OB, OP	51.9(7.6)	87.5 (15)	33.1 (4.9)		3.33	UK	C	Neutral	12		Ad libitum, key CHO foods provided	Agency	
Low GI						55.5(3.8): 133.8(22.9)*****						51.4(6.0):17.0(2.4):32.2(5.1)* ***			
Higher GI						63.9(3): 138.8(30.5)*****						47.6(6.1):17.6(3.3):34.1(5.7)* ***			
Jensen et al. 2008	44 (0M:44F)**	OW, OP	(20-40)¶				3	Denmark	P	Neutral	10		Ad libitum, partial provision, menu plans	Agency, Industry	
Low GI	22 (0M:22F)			77.9(6.9)	27.4 (1.5)	72¥						~57(5):17(0):23(5) ‡			
Higher GI	22 (0M:22F)			80.2(1.4)	27.6 (0.3)	95¥						~57(5):17(0):22(5) ‡			
Philippou et al. 2008	13 (5M:8F)**	≥1 CHD risk factors, OP					NR	UK	P	Negative	12		500kcal CR; Ad libitum	Agency	
Low GI	7 (3M:4F)		54 (49-58)¶¶	81.5 (4.7)***	28.7 (2.1)***	51.3(51.0-52.0): 105.6 (76.9-110.1)¶¶						46.0(37.8-51.0): 17.1(15.7-17.4): 32.8(31.3-37.1)¶¶			
Higher GI	6 (2M:4F)		45 (39-50)¶¶	89.7 (12.8)***	31.5 (4.4)***	59.3(59.2-64.0): 114.7(98.5-134.9)¶¶						49.4(47.8-51.7):19.6(14.0-23.1):29.2(25.2-34.5)¶¶			

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Supplement Table S3c: Trial characteristics continued

Overweight/Obese Trials continued														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Bellisile et al. 2007	65 (0M:65F)**	OW/OB, OP						NR	France	P	Neutral	12		Ad libitum Industry
Low GI	35		46.1 (13.6)	80 (13.2)	30.2 (4.1)	na								
Higher GI	30		45.3 (12.0)	79 (13.1)	30.4 (4.4)	na								
de Rougemont et al. 2007	38 (22M:16F)**	OW, OP					2.8	France	P	Neutral	5		Ad libitum, some foods provided	Agency, Industry
Low GI	19		36.3 (8.7)	77.2 (9.6)	27.5 (1.3)	46.5 (1.3)						42.6 (3.9):19.8 (1.7):37.7 (4.4)		
Higher GI	19		40.4 (9.6)	77.3 (9.2)	27.2 (1.3)	66.3 (2.6)						44.1 (3.5):17.6 (1.7):38.4 (3.1)		
Sichieri et al. 2007	123 (0M:123F)**	OW, OP						NR	Brazil	P	Negative	72	100-300kcal CR; 6-d menu and exchange lists provided	Agency
Low GI	63		37.2 (5.4)*	67.7 (6.6)*	na	21(38): 74(84)						59.5 (6.3): 13.3: 27.2(4.6)		
Higher GI	60		37.5 (5.6)*	68.5 (7.5)*	na	51(28): 199(43)						61.6 (6.2): 12.3: 26.1(4.7)		
McMillian-Price et al. 2006-High Carb	64(16M:48F)	OW/OB, OP						NR	Australia	P	Negative	12		Ad libitum, key foods and meals provided Agency-Industry
Low GI	32		30.5 (7.9)	87.1 (15.3)	30.6 (4.5)	45 (6):89 (28)						56 (6):19 (0):22 (6)		
Higher GI	32		31.8 (9.6)	86 (10.7)	30.9 (3.4)	70 (6):129 (45)						60 (6):18 (6):19 (6)		
McMillian-Price et al. 2006-High Protein	65(15M:50F)	OW/OB, OP						NR	Australia	P	Negative	12		Ad libitum, key foods and meals provided Agency-Industry
Low GI	33		34.6 (8.6)	88.4 (17.2)	32.1 (5.2)	44 (6):59 (23)						40 (11):26 (6):28 (6)		
Higher GI	32		30.2 (8.5)	87.7 (16.4)	31.3 (4.5)	59 (6):75 (17)						42 (6):28 (6):27 (6)		
Wolever et al. 2002	24 (5M:19F)**	IGT, OP						NR	Canada	P	Neutral	16		Ad libitum, partial provision Agency
Low GI	13(3M:10F)		55.2 (10.8)	79.7 (13.1)***	29.7 (4.3)	54.4 (2.5):91.8 (9.4)						54.8 (6.1):19.4 (1.8):24.7 (5.8)		
Higher GI	11(2M:9F)		58.8 (13.3)	76.4 (20.4)***	29.3 (7.3)	59.3 (2.0):96.8 (11.6)						52.8 (6.6):17.4 (2.3):27.9 (6.3)		



Supplement Table S3d: Trial characteristics continued

Diabetes Trials															
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source	
Jenkins et al. 2014	141(77M:64F)	T2DM, OP						NR	Canada	P	Neutral	12		Ad libitum, bread supplement	Industry Association
Low GI	70 (38M:32F)		59 (10)	85 (20)	30 (5)	~51:53						~38.5:19.8:37.2			
Higher GI	71 (39M:32F)		59 (10)	84 (19)	31 (6)	~62:89						~49.2:19.8:27.4			
Visek et al. 2014	20 (12M:8F)	T2DM, OP	62.7 (5.8)	91.9 (14.1)	32 (4.2)			NR	Czech Republic	C	Neutral	12		Ad libitum	Agency
Low GI						49 (48-51)¶¶¶						~37.2:18.0:36.0			
Higher GI						68 (61-72)¶¶¶						~36.2:17.3:40.0			
Jenkins et al. 2012	121 (61M: 60F)	T2DM, OP						NR	Canada	P	Neutral	12		Ad libitum	Agency
Low GI	60		58 (10.1)	85.6 (20.1)	31.4 (7.0)	47: 80						45.4:22.8:30.5			
Higher GI	61		61 (7.8)	82.5 (17.2)	29.9 (5.5)	58: 100						48.3:21.4:28.5			
Yusof et al. 2009	100**	T2DM, OP	NR					NR	Malaysia	P	Neutral	12		Ad libitum, key foods provided to lowGI group	Agency
Low GI	51			69.12 (13.33)	27.05 (4.91)	57(6): 108(32)						52(4):18(3):30(4)			
Higher GI	49			66.83 (11.50)	26.79 (4.65)	64(5): 131(30)						54(4):17(3):28(5)			
Jenkins et al 2008	210 (125M:82F)	T2DM, OP						NR	Canada	P	Neutral	24		Ad libitum	Agency
Low GI	106 (65M:41F)		60 (10)	87.0 (20.0)	30.6 (6.0)	49.4: 91.5						44.0:21.2:33.3			
Higher GI	104 (63M:41F)		61 (9)	87.8 (19.4)	31.2 (5.8)	59.3: 117.9						47.5:20.7:30.5			
Wolever et al. 2008	103	T2DM, OW/OB, OP						NR	Canada	P	Neutral	52		Ad libitum, key foods provided	Agency
Low GI	55		60.6 (7.5)*	81.1 (18.7)*	31.6 (4.5)*	55.1 (3.0): 133 (14.8)						51.9 (6.7):20.6(3.0):26.5 (5.9)			
Higher GI	48		60.4 (7.9)*	84.4(18.0)*	30.1 (4.3)*	63.2 (2.8): 135 (20.8)						46.5 (6.2):20.4 (2.8):30.8 (4.8)			

Supplement Table S3e: Trial characteristics continued

Diabetes Trials continued															
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶¶¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source	
Jimenez-Cruz et al. 2003	14 (6M:8F)**	T2DM, OP	59 (34)					NR	Mexico	C	Neutral	6		Ad libitum	Industry
Low GI				91.6 (24.3)	32.4 (6.0)	44(3.4): 86(19.8)						60:21:23			
Higher GI				92.6 (25.4)	32.3 (6.0)	56(4.9): 139(27.3)						64:18:20			
Heilbronn et al. 2002	45 (23M:22F)**	T2DM, OW, OP						3.5	Australia	P	Negative	8		CR to1500kcal/d; Ad libitum, partial provision	Unknown
Low GI	24 (11M:13F)		56.0(9.4)	91.7(16.2)		43						58.9 (2.9):22.2 (1.5):17.9 (3.9)			
Higher GI	21 (12M:9F)		57.5(9.6)	93.2 (13.3)		75						60.8 (2.3):21.7 (0.9):17.1 (2.3)			
Fontvieille et al. 1992	18 (12M:6F)	T1DM/T2DM, OP	47.2(11.6)		24.8(2.6)			4.7	France	C	Neutral	5		Ad libitum	Agency, Industry
Low GI						38.1(5.3)						45.8(7.2):18.0(2.5):36.2(6.8)			
Higher GI						64.2(3.1)						44.9(7.3):18.8(1.6):36.3(6.0)			
Fontvieille et al. 1988	8 (4M:4F)	T1DM, OP	43.5 (9.9)		24.1 (6.8)			3.5	France	C	Neutral	3		Ad libitum, partial provision	Agency, Industry
Low GI						46.5(2.5)						46.1 (4.5):17.4 (1.4):35.0 (2.8)			
Higher GI						60.1 (5.1)						45.4 (4.5):16.9 (1.7):36.0 (2.8)			
CHD Trial															
Frost et al. 2004	55 (48M:7F)**	CHD, OP						NR	UK	P	Neutral §§§	12		Ad Libitum	Unknown
Low GI	26 (23M:3F)		63.6 (9.4)	81.2 (12.2)	26.9 (3.3)	50(4):115(39)						49 (5):18 (5):31 (5)			
Higher GI	29 (25M:4F)		61.8 (9)	81.7 (16.7)	28.7 (4.6)	57(4):106(34)						47 (10):18 (5):32 (10)			

Abbreviations: BMI=Body Mass Index; C=Crossover design; Carb=Carbohydrate; CED= carbohydrate exchange diet; CHD= Coronary Heart Disease; CR= calorie restriction; CV=cardiovascular; GI= glycemic index; GL=glycemic load; IGT= impaired glucose tolerance; IP=inpatient; IR= insulin resistant; High Carb= high carbohydrate; HI= hyperinsulinemic; M = male; mo=months; MUFA=monounsaturated fatty acids; na=not available; T1DM=type 1 diabetes mellitus; T2DM = type 2 diabetes mellitus; OB= obese; OH=otherwise healthy; OP = outpatient; OW= overweight; P=Parallel design; SD= standard deviation; F = female; UK= United Kingdom; USA= United States of America; wks=weeks; y= years

§Negative energy balance diets were designed for weight loss, Neutral energy balance diets for weight maintenance, where all diets are isocaloric between test and control groups; §§Energy from carbohydrate: protein: fat for the planned diet or if not planned; §§§ Participants were advised to lose weight if they had a BMI>28kg/m2.

¶ Range of values; ¶¶ median and interquartile range (IQR); ¶¶¶ Actual GI/GL or if not available, planned;

* Calculated before dropout; **Completer Analysis, as used in data analysis; *** completer analysis, data obtained from authors; **** based on less participants than in analysis;

+ approximate based on all study arms; ¥ approximate based on test meals; ‡ approximate based on n=45 from Sloth et al. 2004, the original publication of this study;

‡‡‡ analysis includes weight loss and weight maintenance phases

Supplemental Table S4: Sensitivity analysis of the systematic removal of each trial*

	MD [95% CI], P-value I ² , P-value					
	Body Weight (kg) N=32	BMI (kg/m ²) N=18	Body Fat (%) N=10	Waist Circumference (cm) N=18	Waist-to-hip Ratio N=6	Sagittal Abdominal Diameter (cm) N=3
All studies	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.91	-0.01 [-0.58, 0.56], P=0.98 65%, P=0.003	-0.46 [-1.05, 0.14], P=0.13 62%, P<0.01	-0.00 [-0.01, 0.00], P=0.27 0.00%, P=0.52	-0.09 [-0.34, 0.16], P=0.48 0.00%, P=0.92
Removal of:						
OW/OB						
Pereira et al. 2015	-0.61 [-0.82, -0.39], P<0.01 0.00%, P=0.54	-0.24 [-0.34, -0.14], P<0.01 0.00%, P=0.93	0.19 [-0.25, 0.63], P=0.39 36%, P=0.13	-0.37 [-1.04, 0.31], P=0.28 62%, P<0.01	-0.00 [-0.01, 0.01], P=0.67 0.00%, P=0.58	n/a
Karl et al. 2015	-0.62 [-0.83, -0.41], P<0.01 0.00%, P=0.50	-0.25 [-0.35, -0.16], P<0.01 0.00%, P=0.91	0.10 [-0.51, 0.71], P=0.74 64%, P<0.01	n/a	n/a	n/a
Buscemi et al. 2013	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.86	-0.08 [-0.63, 0.48], P=0.79 64%, P<0.01	-0.46 [-1.06, 0.15], P=0.14 64%, P<0.01	n/a	n/a
Costa et al. 2012	-0.62 [-0.84, -0.41], P<0.01 0.00%, P=0.46	-0.26 [-0.37, -0.16], P<0.01 0.00%, P=0.86	-0.06 [-0.73, 0.61], P=0.86 66%, P<0.01	-0.33 [-0.94, 0.28], P=0.29 59%, P<0.01	n/a	n/a
Jebb et al. 2010 - LowFat	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Larsen et al. 2010 - LowPro	-0.60 [-0.81, -0.38], P<0.01 0.00%, P=0.57	n/a	n/a	-0.45 [-1.09, 0.18], P=0.16 64%, P<0.01	n/a	-0.05 [-0.39, 0.29], P=0.79 0.00%, P=0.86
Jebb et al. 2010- HighMUFA	-0.64 [-0.85, -0.43], P<0.01 0.00%, P=0.65	n/a	n/a	n/a	n/a	n/a
Larsen et al. 2010 - HighPro	-0.62 [-0.83, -0.41], P<0.01 0.00%, P=0.48	n/a	n/a	-0.37 [-1.00, 0.26], P=0.26 62%, P<0.01	n/a	-0.13 [-0.45, 0.19], P=0.42 0.00%, P=0.92
Solomon et al. 2010	-0.63 [-0.84, -0.42], P<0.01	-0.26 [-0.36, -0.16], P<0.01	n/a	n/a	n/a	n/a

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	0.00%, P=0.47	0.00%, P=0.88				
Philippou et al. 2009 - 6mth	-0.65 [-0.86, -0.44], P<0.01 0.00%, P=0.59	-0.28 [-0.37, -0.18], P<0.01 0.00%, P=0.97	-0.12 [-0.71, 0.48], P=0.70 65%, P<0.01	-0.55 [-1.15, 0.04], P=0.07 61%, P<0.01	n/a	n/a
Philippou et al. 2009 - 4mth	-0.61 [-0.83, -0.40], P<0.01 0.00%, P=0.48	-0.25 [-0.35, -0.15], P<0.01 0.00%, P=0.89	-0.09 [-0.72, 0.54], P=0.78 66%, P<0.01	-0.44 [-1.08, 0.19], P=0.17 64%, P<0.01	n/a	n/a
Abete et al. 2008	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	n/a	n/a	n/a	n/a	n/a
Philippou et al. 2008	-0.62 [-0.83, -0.42], P<0.01 0.00%, P=0.48	-0.26 [-0.35, -0.16], P<0.01 0.00%, P=0.89	-0.06 [-0.68, 0.55], P=0.84 68%, P<0.01	-0.41 [-1.02, 0.19], P=0.18 63%, P<0.01	n/a	n/a
Aston et al. 2008	-0.66 [-0.87, -0.44], P<0.01 0.00%, P=0.52	n/a	-0.00 [-0.70, 0.69], P=0.99 68%, P<0.01	-0.54 [-1.14, 0.07], P=0.08 62%, P<0.01	n/a	n/a
Jensen et al. 2008	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.27 [-0.36, -0.17], P<0.01 0.00%, P=0.88	n/a	-0.44 [-1.05, 0.18], P=0.16 64%, P<0.01	-0.00 [-0.01, 0.00], P=0.24 0.00%, P=0.41	-0.09 [-0.35, 0.18], P=0.51 0.00%, P=0.69
de Rougemont et al. 2007	-0.57 [-0.80, -0.34], P<0.01 0.00%, P=0.53	-0.25 [-0.36, -0.14], P<0.01 0.00%, P=0.87	0.06 [-0.57, 0.70], P=0.84 67%, P<0.01	n/a	n/a	n/a
Sichieri et al. 2007	-0.66 [-0.88, -0.45], P<0.01 0.00%, P=0.53	n/a	n/a	n/a	n/a	n/a
Bellisle et al. 2007	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.88	n/a	-0.47 [-1.08, 0.13], P=0.13 64%, P<0.01	-0.00 [-0.01, 0.00], P=0.14 0.00%, P=0.70	n/a
McMillan-Price et al. 2006 - HighCHO	-0.61 [-0.82, -0.39], P<0.01 0.00%, P=0.51	n/a	n/a	-0.38 [-1.01, 0.25], P=0.23 63%, P<0.01	n/a	n/a
McMillan-Price et al. 2006 - HighPro	-0.70 [-0.91, -0.49], P<0.01 0.00%, P=0.91	n/a	n/a	-0.62 [-1.19, -0.05], P=0.03 55%, P<0.01	n/a	n/a
Wolever et al. 2002	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Diabetes:						
Visek et al. 2014	-0.63 [-0.84, -0.42], P<0.01	-0.26 [-0.36, -0.16], P<0.01	0.01 [-0.57, 0.60], P=0.96	n/a	n/a	n/a

	0.00%, P=0.46	0.00%, P=0.86	68%, P<0.01			
Jenkins et al. 2014	-0.66 [-0.88, -0.43], P<0.01 0.00%, P=0.47	-0.29 [-0.39, -0.18], P<0.01 0.00%, P=0.94	n/a	-0.61 [-1.18, -0.04], P=0.04 50%, P=0.01	-0.00 [-0.01, 0.00], P=0.21 0.00%, P=0.43	n/a
Jenkins et al. 2012	-0.62 [-0.84, -0.40], P<0.01 0.00%, P=0.46	-0.25 [-0.35, -0.15], P<0.01 0.00%, P=0.87	n/a	-0.44 [-1.05, 0.17], P=0.16 64%, P<0.01	-0.00 [-0.01, 0.01], P=0.64 0.00%, P=0.53	n/a
Yusof et al. 2009	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.87	n/a	-0.33 [-0.95, 0.28], P=0.29 58%, P<0.01	n/a	n/a
Jenkins et al. 2008	-0.61 [-0.83, -0.40], P<0.01 0.00%, P=0.48	-0.25 [-0.36, -0.15], P<0.01 0.00%, P=0.87	n/a	n/a	n/a	n/a
Wolever et al. 2008	-0.64 [-0.84, -0.43], P<0.01 0.00%, P=0.57	n/a	n/a	-0.50 [-1.10, 0.09], P=0.10 62%, P<0.01	n/a	n/a
Jimenez-Cruz et al. 2003	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.35, -0.16], P<0.01 0.00%, P=0.86	n/a	n/a	n/a	n/a
Heilbronn et al. 2002	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	n/a	n/a	n/a	n/a	n/a
Fontvieille et al. 1992	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Fontvielle et al. 1988	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
CHD						
Frost et al. 2004	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	-0.26 [-0.36, -0.17], P<0.01 0.00%, P=0.89	n/a	-0.48 [-1.09, 0.12], P=0.12 63%, P<0.01	-0.00 [-0.01, 0.00], P=0.25 1%, P=0.40	n/a

*Sensitivity analysis included the removal of each single study from the meta-analyses one at a time and the summary effect was recalculated. An influential outlier was considered a study whose removal changed the magnitude of the pooled effect by >10%.

BMI, body mass index; CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; MD, mean difference; mnth, month; MUFA, monounsaturated fatty acids; n/a, not applicable; OB, obese; OW, overweight; Pro, protein

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Supplemental Table S5: Sensitivity analyses of the use of correlation coefficients of 0.25 and 0.75 for crossover trials

Outcome (no. crossover trials/total)	MD (95% CI), P-value I ² , P-value		
	Correlation Coefficient used in the Primary Analysis	Correlation Coefficient used in Sensitivity Analyses	
	0.5	0.25	0.75
Body Weight, kg (6*/32)	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.63 [-0.84, -0.43], P<0.01 0.00%, P=0.51
BMI, kg/m ² (3/18)	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.91	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.90	-0.26 [-0.35, -0.17], P<0.01 0.00%, P=0.90
Body Fat, % (3*/10)	-0.01 [-0.58, 0.56], P=0.98 65%, P<0.01	-0.00 [-0.58, 0.58], P=0.99 64%, P<0.01	-0.02 [-0.57, 0.54], P=0.96 66%, P<0.01
Waist Circumference, cm (2*/18)	-0.46 [-1.05, 0.14], P=0.13 62%, P<0.01	-0.44 [-1.04, 0.15], P=0.14 60%, P<0.01	-0.46 [-1.07, 0.14], P=0.13 65%, P<0.01
Waist-to-hip Ratio (0/6)	-0.00 [-0.01, 0.00], P=0.27 0.00%, P=0.52	n/a	n/a
Sagittal Abdominal Diameter, cm (0/6)	-0.09 [-0.34, 0.16], P=0.48 0.00%, P=0.92	n/a	n/a

* one of these crossover trials, however, did not require the use of a correlation coefficient as complete data was available

BMI, body mass index; CI, confidence interval; MD, mean difference; no., number

Supplement Table S6. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on body weight (kg)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	24.1 – 37.1 kg/m ²	32	2448	-0.04 (-0.13, 0.06)	0.00%	0.454
Follow-up	3 – 72 wks	32	2448	0.01 (-0.01, 0.02)	0.00%	0.314
Dose Pasta	1.75 – 7.0 serv/wk	11	740	0.29 (-0.91, 1.50)	0.00%	0.595
GI ³	21 - 72	31	2383	-0.01 (-0.04, 0.02)	0.45%	0.482
Difference in GI ²	4.9 - 40.2	31	2383	-0.00 (-0.04, 0.03)	2.75%	0.811
Fiber ³	8.0 - 39.4g/d	27	1851	0.02 (-0.01, 0.06)	0.00%	0.221
Change in Fiber ⁴	-7.5 - +13.8g/d	17	1571	-0.02 (-0.07, 0.04)	23.13%	0.595
Difference in Fiber ²	-8.5 - +15.3g/d	27	1851	-0.01 (-0.06, 0.04)	0.00%	0.701
Saturated Fat ³	5.1 - 12.5%	14	1396	-0.05 (-0.30, 0.20)	34.32%	0.648
Change in Saturated Fat ⁴	-8.2 - -1.2%	12	1309	-0.01 (-0.29, 0.28)	46.27%	0.965
Difference in Saturated Fat ²	-2.0 - +2.3%	14	1396	-0.34 (-1.08, 0.39)	32.80%	0.329
CHO ³	37.2 - 68.0%	30	2345	-0.01 (-0.05, 0.03)	0.00%	0.541
Change in CHO ⁴	-7.2 - +10.1%	19	2046	-0.07 (-0.12, -0.01)	0.00%	0.016
Difference in CHO ²	-11.1 - +5.4%	30	2345	0.02 (-0.05, 0.10)	0.00%	0.547
Protein ³	13.3 - 26.1%	30	2345	0.04 (-0.04, 0.12)	0.00%	0.332

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Change in Protein ⁴	-0.5 - +8.6%	19	2046	0.15 (0.03, 0.27)	0.00%	0.017
Difference in Protein ²	-2.5 - +3.4%	30	2345	-0.18 (-0.38, 0.02)	0.00%	0.069
Fat ³	16.0 - 37.7%	30	2345	0.01 (-0.05, 0.06)	0.00%	0.852
Change in Fat ⁴	-12.2 - +5.4%	19	2046	0.05 (-0.02, 0.12)	17.73%	0.122
Difference in Fat ²	-4.4 - +10.6%	30	2345	0.02 (-0.05, 0.09)	0.00%	0.610

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in body weight on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in body weight. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

- 2 Difference in diet variable between the intervention and control arms
- 3 Intake at the end of study in the intervention arm
- 4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index

Supplemental Table S7. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on BMI (kg/m²)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 37.1 kg/m ²	18	1038	-0.01 (-0.06, 0.03)	0.00%	0.559
Follow-up	4 – 24 wks	18	1038	0.00 (-0.01, 0.02)	0.00%	0.559
Dose Pasta*	2.33 – 7.0 serv/wk	4	143			
GI ³	39.8 - 72	17	973	0.01 (-0.01, 0.03)	0.00%	0.153
Difference in GI ²	7.0 - 40.2	17	973	-0.01 (-0.03, 0.01)	0.00%	0.275
Fiber ³	8.0 - 39.4g/d	16	935	0.01 (-0.01, 0.02)	0.00%	0.366
Change in Fiber ⁴	-1.8 - +12.4g/d	10	758	0.00 (-0.03, 0.03)	0.00%	0.846
Difference in Fiber ²	-4.9 - +13.0g/d	16	935	-0.00 (-0.02, 0.02)	0.00%	0.821
Saturated Fat* ³	7.6 - 12.5%	7				
Change in Saturated Fat* ⁴	-2.4 - -1.2%	6				
Difference in Saturated Fat* ²	-1.0 - +2.3%	7				
CHO ³	37.2 - 68.0%	16	935	-0.00 (-0.02, 0.01)	0.00%	0.594
Change in CHO ⁴	-5.6 - +3.2%	10	758	-0.02 (-0.06, 0.02)	0.00%	0.325
Difference in CHO ²	-11.1 - +2.0%	16	935	-0.01 (-0.03, 0.02)	0.00%	0.531
Protein ³	13.9 – 22.8%	16	935	0.00 (-0.04, 0.04)	0.00%	0.905

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Change in Protein ⁴	-0.2 - +3.0%	10	758	0.01 (-0.11, 0.14)	0.00%	0.786
Difference in Protein ²	-2.5 - +3.4%	16	935	-0.03 (-0.12, 0.06)	0.00%	0.441
Fat ³	16.0 - 37.7%	16	935	0.00 (-0.02, 0.02)	0.00%	0.717
Change in Fat ⁴	-4.8 - +5.4%	10	758	0.02 (-0.02, 0.06)	0.00%	0.240
Difference in Fat ²	-4.4 - +10.6%	16	935	0.01 (-0.01, 0.04)	0.00%	0.299

*For Dose, there were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in BMI on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in BMI. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran’s Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplemental Table S8. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on body fat (%)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 36.0 kg/m ²	10	285	-0.02 (-0.26, 0.23)	67.69%	0.890
Follow-up	4 – 24 wks	10	285	0.06 (-0.06, 0.17)	66.00%	0.303
Dose Pasta*	2.33 - 3.33 serv/wk	3	96			
GI ³	39.8 - 72	10	285	0.12 (-0.00, 0.25)	52.21%	0.053
Difference in GI ²	7.0 - 40.2	10	285	-0.09 (-0.15, -0.03)	19.39%	0.008
Fiber* ³	8.0 - 39.4g/d	8	228			
Change in Fiber* ⁴	-1.8 - +12.4g/d	4	87			
Difference in Fiber* ²	-4.9 - +13.0g/d	8	228			
Saturated Fat* ³	7.6 - 12.5%	3	93			
Change in Saturated Fat* ⁴	-2.4 - -1.2%	2	51			
Difference in Saturated Fat* ²	-1.0 - +2.3%	3	93			
CHO* ³	37.2 - 68.0%	9	247			
Change in CHO* ⁴	-5.6 - +3.2%	4	87			
Difference in CHO* ²	-11.1 - +2.0%	9	247			
Protein* ³	13.9 – 22.8%	9	247			

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Change in Protein* ⁴	-0.2 - +3.0%	4	87			
Difference in Protein* ²	-2.5 - +3.4%	9	247			
Fat* ³	16.0 - 37.7%	9	247			
Change in Fat* ⁴	-4.8 - +5.4%	4	87			
Difference in Fat* ²	-4.4 - +10.6%	9	247			

*There were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in body fat on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in body fat. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran’s Q statistic.

- 2 Difference in diet variable between the intervention and control arms
- 3 Intake at the end of study in the intervention arm
- 4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplemental Table S9. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 36.0 kg/m ²	18	1380	0.10 (-0.13, 0.32)	59.02%	0.372
Follow-up	4 – 52 wks	18	1380	0.05 (-0.03, 0.13)	60.50%	0.225
Dose Pasta*	3.0 – 3.33 serv/wk	2	63			
GI ³	41.2 – 72.0	17	1315	-0.01 (-0.12, 0.10)	66.00%	0.841
Difference in GI ²	4.9 – 32.9	17	1315	-0.02 (-0.10, 0.06)	64.51%	0.596
Fiber ³	8.0 - 39.4g/d	15	1258	0.05 (-0.05, 0.14)	59.60%	0.342
Change in Fiber ⁴	-1.8 - +13.8g/d	13	1176	0.01 (-0.17, 0.20)	70.59%	0.861
Difference in Fiber ²	-4.9 - +15.3g/d	15	1258	-0.00 (-0.14, 0.13)	64.86%	0.939
Saturated Fat* ³	6.1 – 10.1%	8	604			
Change in Saturated Fat* ⁴	-7.6 - -1.2%	7	562			
Difference in Saturated Fat* ²	-2.0 - +2.3%	8	604			
CHO ³	38.5 - 58.6%	16	1277	-0.11 (-0.19, -0.04)	27.06%	0.007
Change in CHO ⁴	-7.2 - +10.1%	13	1176	-0.09 (-0.23, 0.04)	57.19%	0.148
Difference in CHO ²	-11.1 - +5.4%	16	1277	-0.01 (-0.18, 0.17)	60.81%	0.947
Protein ³	13.9 – 26.1%	16	1277	0.20 (0.01, 0.38)	43.92%	0.038

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Change in Protein ⁴	-0.3 - +8.6%	13	1176	0.19 (-0.09, 0.46)	63.38%	0.165
Difference in Protein ²	-2.5 - +3.4%	16	1277	-0.14 (-0.66, 0.38)	62.79%	0.570
Fat ³	22.0 - 37.2%	16	1277	0.10 (-0.05, 0.26)	53.48%	0.185
Change in Fat ⁴	-12.2 - +5.4%	13	1176	0.08 (-0.07, 0.24)	61.15%	0.274
Difference in Fat ²	-4.4 - +10.6%	16	1277	0.09 (-0.06, 0.25)	47.17%	0.220

*There were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in waist circumference on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in waist circumference. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

- 2 Difference in diet variable between the intervention and control arms
- 3 Intake at the end of study in the intervention arm
- 4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplementary Table S10. Post-hoc piecewise linear continuous dose-response meta-regression analyses for the effect of pasta intake in the context of low-GI dietary patterns on body weight (kg)

Dose threshold of servings of pasta consumed per week	Dose ranges of servings of pasta consumed per week	β (95% CIs) *	Residual I^2 †	p -value
3.0	≤ 3.0	-0.70 (-3.27, 1.86)	0.00%	0.890
	> 3.0	0.91 (-0.89, 2.70)		
3.33	≤ 3.33	0.05 (-1.80, 1.89)	0.00%	0.518
	> 3.33	0.44 (-1.75, 2.63)		
3.5	≤ 3.5	0.09 (-1.65, 1.82)	0.00%	0.888
	> 3.5	0.46 (-1.89, 2.81)		

* β is the slope derived from the piecewise linear meta-regression analyses and represents the treatment effect on body weight for doses above and below each dose-threshold representing servings of pasta consumption per week; † The residual I^2 value indicates heterogeneity unexplained by each dose-threshold.

Supplementary Table S11: GRADE assessment of study quality

Quality assessment*							№ of patients		Effect	Quality Importance
№ of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Pasta/LGI diet	Higher GI diet	Absolute (95% CI)	
Body Weight (follow up: median 12 weeks)										
32	randomised trials	not serious	not serious	serious ^a	not serious	none	1294	1228	MD -0.63 kg (-0.84 to -0.42)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
BMI (follow up: median 12 weeks)										
18	randomised trials	not serious	not serious	serious ^a	not serious	none	551	538	MD -0.26 kg/m² (-0.36 to -0.16)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
Waist Circumference (follow up: median 12 weeks)										
18	randomised trials	not serious	serious ^b	serious ^a	not serious	none	717	624	MD -0.46 cm (-1.05 to 0.14)	⊕⊕○○ LOW ^{a,b} Due to downgrade for inconsistency and indirectness

Quality assessment*							№ of patients		Effect	Quality Importance
№ of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Pasta/LGI diet	Higher GI diet	Absolute (95% CI)	
Body Fat (follow up: median 12 weeks)										
10	randomised trials	not serious	serious ^c	serious ^a	not serious	none	176	165	MD -0.01 % (-0.58 to 0.56)	⊕⊕○○ LOW ^{a,c} Due to downgrade for inconsistency and indirectness
Waist-to-hip Ratio (follow up: median 12 weeks)										
6	randomised trials	not serious	not serious	serious ^a	not serious	none ^d	223	222	MD -0.00 (-0.01 to 0.00)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
Sagittal Abdominal Diameter (follow up: median 26 weeks)										
3	randomised trials	not serious	not serious	serious ^a	not serious	none ^d	237	214	MD -0.09 cm (-0.34 to 0.16)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness

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3 CI, Confidence interval; GI, glycemic index; LGI, low glycemic index; MD, Mean difference
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5 *All outcomes started with high quality evidence since all studies were randomized controlled trials. Risk of Bias –We rated down for
6 risk of bias if the majority of studies were considered to be at high risk of bias. Inconsistency – We assessed inconsistency using I^2
7 estimates where an I^2 of 50% or higher indicates substantial heterogeneity. I^2 is the percentage of variability in the treatment estimates
8 that is attributable to heterogeneity between studies. We rated down for inconsistency if there was substantial heterogeneity that was
9 unexplained by any a priori sensitivity or subgroup analyses. Indirectness – We rated down for indirectness if there were factors
10 present relating to the population, interventions, and outcomes that limited the generalizability of the results. Imprecision – We rated
11 down for imprecision if the 95% confidence interval (95% CI) crossed the minimally important difference (MID) for harm. MID used
12 for each outcome are: 0.5kg for body weight (based on Johnston et al. JAMA 2014;312(9):923-33); 0.2kg/m² for BMI; 2.0cm for
13 waist circumference; 2.0% for body fat; 0.02 for waist-to-hip ratio; 2.0cm for sagittal abdominal diameter.
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17 a. Downgrade for serious indirectness, since most of the available trials did not quantify the amount of pasta consumed in the context
18 of the low-GI dietary patterns
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20 b. Downgrade for serious inconsistency, as there was evidence of substantial inter-study ($I^2=62%$, P-heterogeneity<0.001), which
21 could not be explained
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23 c. Downgrade for serious inconsistency, as there was evidence of substantial inter-study ($I^2= 65%$, P-heterogeneity=0.003), which
24 could not be explained
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26 d. No downgrade for publication bias, as publication bias could not be assessed due to lack of power for assessing funnel plot
27 asymmetry and small study effects (<10 trials included in the meta-analysis)
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Supplemental Table S12: PRISMA Checklist



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-6, Supplemental Table S2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5, Supplemental Table S1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplemental Table S1

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Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6, Supplemental Table S2
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	7-9

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7-8
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9-11, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-11, Table 1, Supplemental Tables S2-S3
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	11, Supplemental Figures S1-S2

Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11-12, Figures 2-3, Supplemental Figures S3-S7
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	11-12, Figures 2-3, Supplemental Figures S3-S7
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	11, Supplemental Table S1, S2, S12, S15, S17, S20
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	12-15, Supplemental Tables S4-S10, Supplemental Figures S8-S26
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16-19
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	19-21
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	21-22
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	25-26

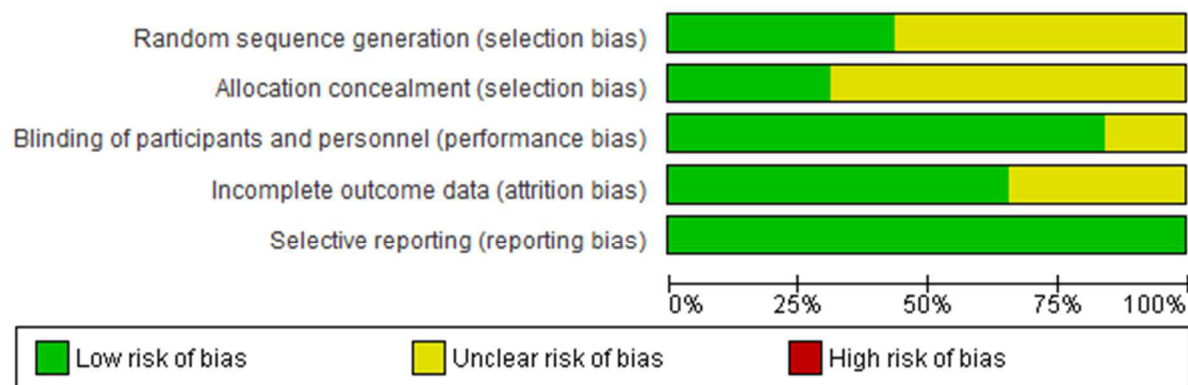
From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Supplemental Figures

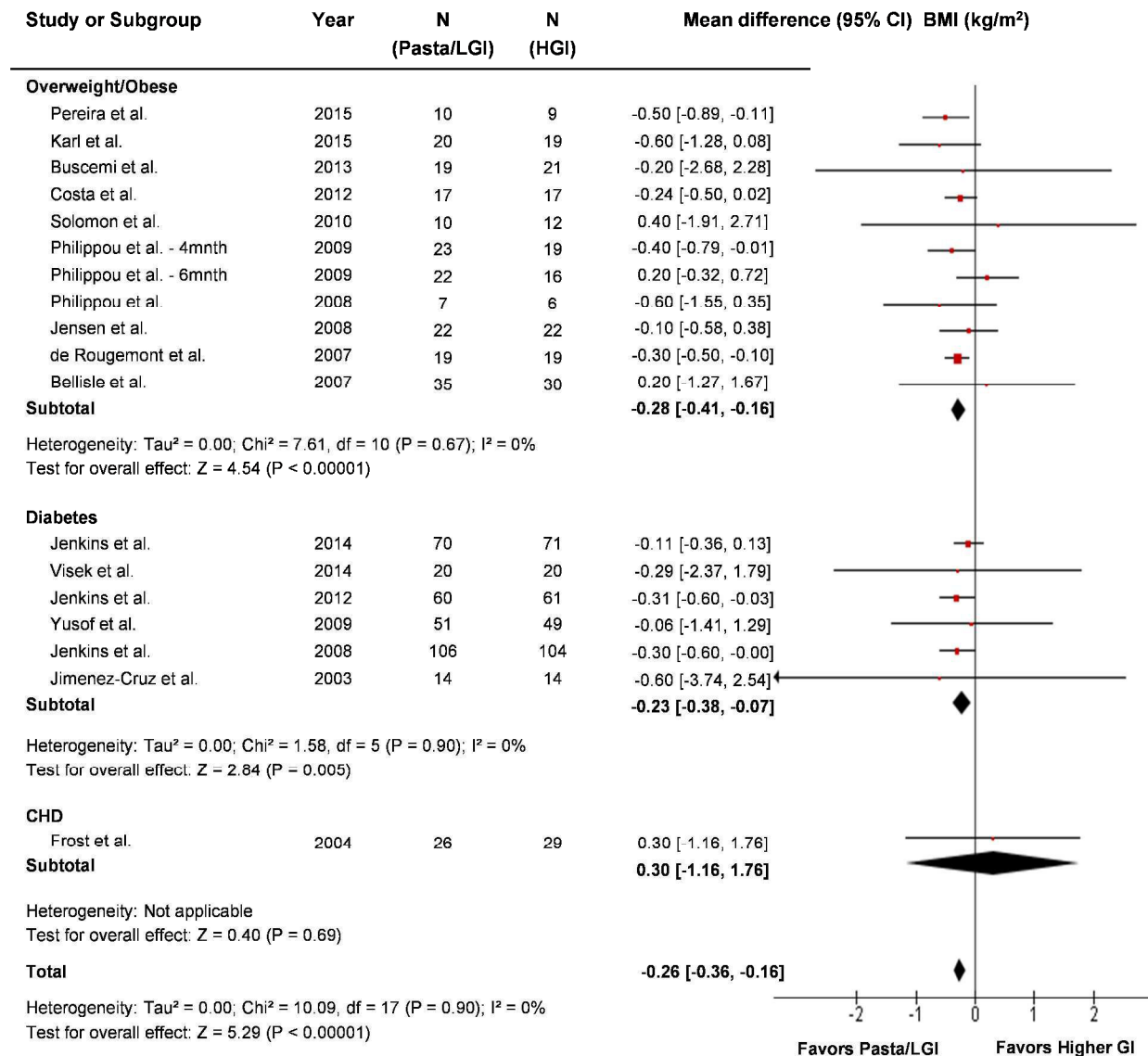
	Random Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel and Outcome Assessment	Incomplete Outcome Data	Selective Reporting		Random Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel and Outcome Assessment	Incomplete Outcome Data	Selective Reporting
Abete et al. 2008	?	?	?	+	+	Jimenez-Cruz et al. 2003	?	?	?	?	+
Aston et al. 2008	+	?	+	+	+	Karl et al. 2015	+	+	+	+	+
Bellisle et al. 2007	?	?	?	?	+	Larsen et al. 2010 -LowPro	+	+	+	+	+
Buscemi et al. 2012	+	+	+	?	+	Larsen et al. 2010 -HighPro	+	+	+	+	+
Cost et al. 2012	?	?	+	+	+	McMillan-Price et al. 2006- HighCHO	?	?	+	+	+
de Rougemont et al. 2007	?	+	+	+	+	McMillan-Price et al. 2006- HighPro	?	?	+	+	+
Fontvielle et al. 1992	?	?	+	+	+	Pereira et al. 2015	?	?	+	?	+
Fontvielle et al. 1988	?	?	+	+	+	Philippou et al. 2008	?	?	+	?	+
Frost et al. 2004	?	?	+	+	+	Philippou et al. 2009-4mo	?	?	+	?	+
Heilbronn et al. 2002	?	?	+	?	+	Philippou et al. 2009-6mo	?	?	?	?	+
Jebb et al. 2010 - HighMUFA	+	?	+	?	+	Sicheri et al. 2007	+	?	+	?	+
Jebb et al. 2010 - LowFat	+	?	+	?	+	Solomon et al. 2010	?	?	+	+	+
Jenkins et al. 2014	+	+	+	+	+	Visek et al. 2014	?	?	+	+	+
Jenkins et al. 2012	+	+	+	+	+	Wolever et al. 2008	+	+	?	+	+
Jenkins et al. 2008	+	+	+	+	+	Wolever et al. 2002	+	+	+	+	+
Jensen et al. 2008	?	?	+	+	+	Yusof et al. 2009	+	?	+	+	+

Supplemental Figure S1: Cochrane risk of bias summary for all included trials
 Summary of risk of bias ratings for each individual study included in the meta-analysis.



Supplemental Figure S2: Risk of bias proportion graph for all included trials

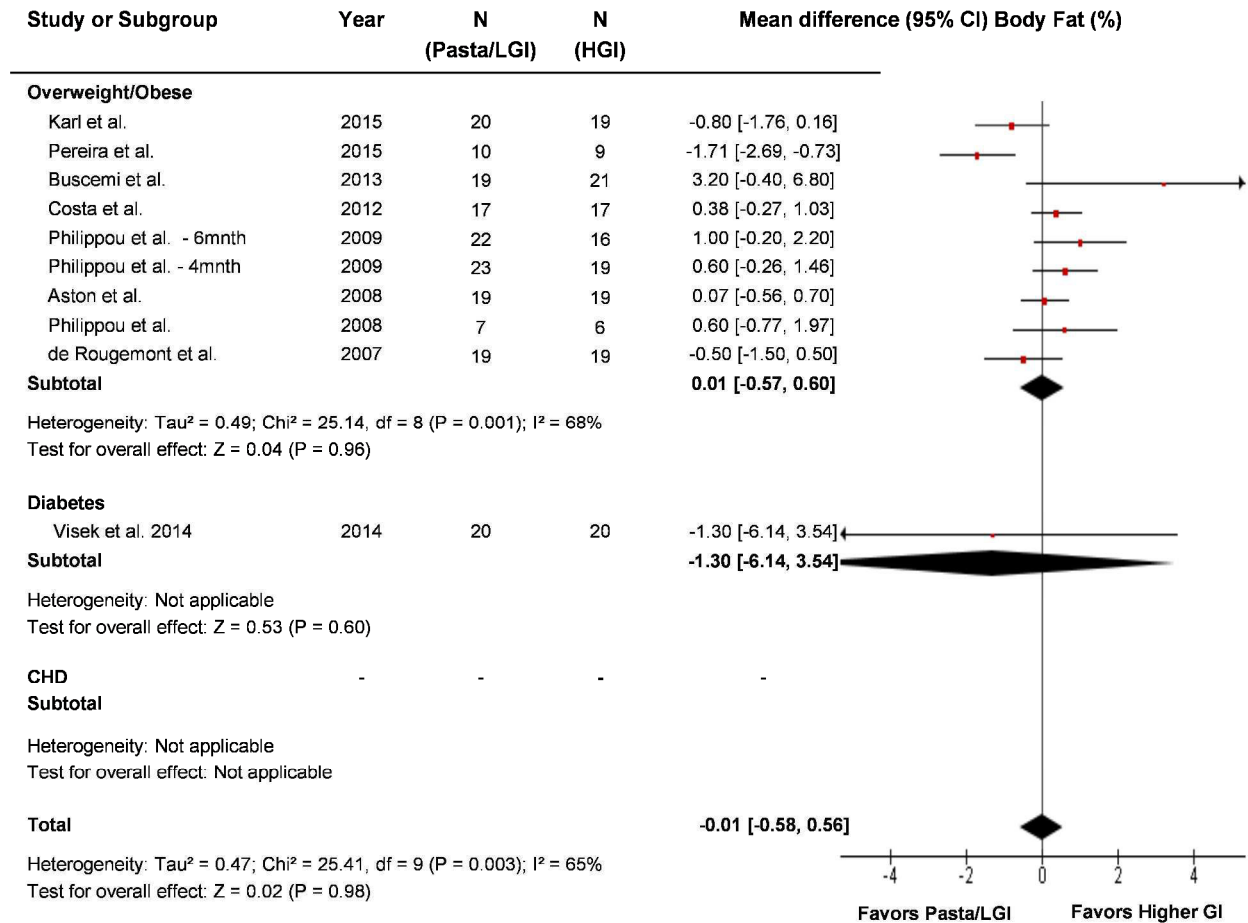
Peer review only



Supplemental Figure S3: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on BMI (kg/m²) (n= 1038)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

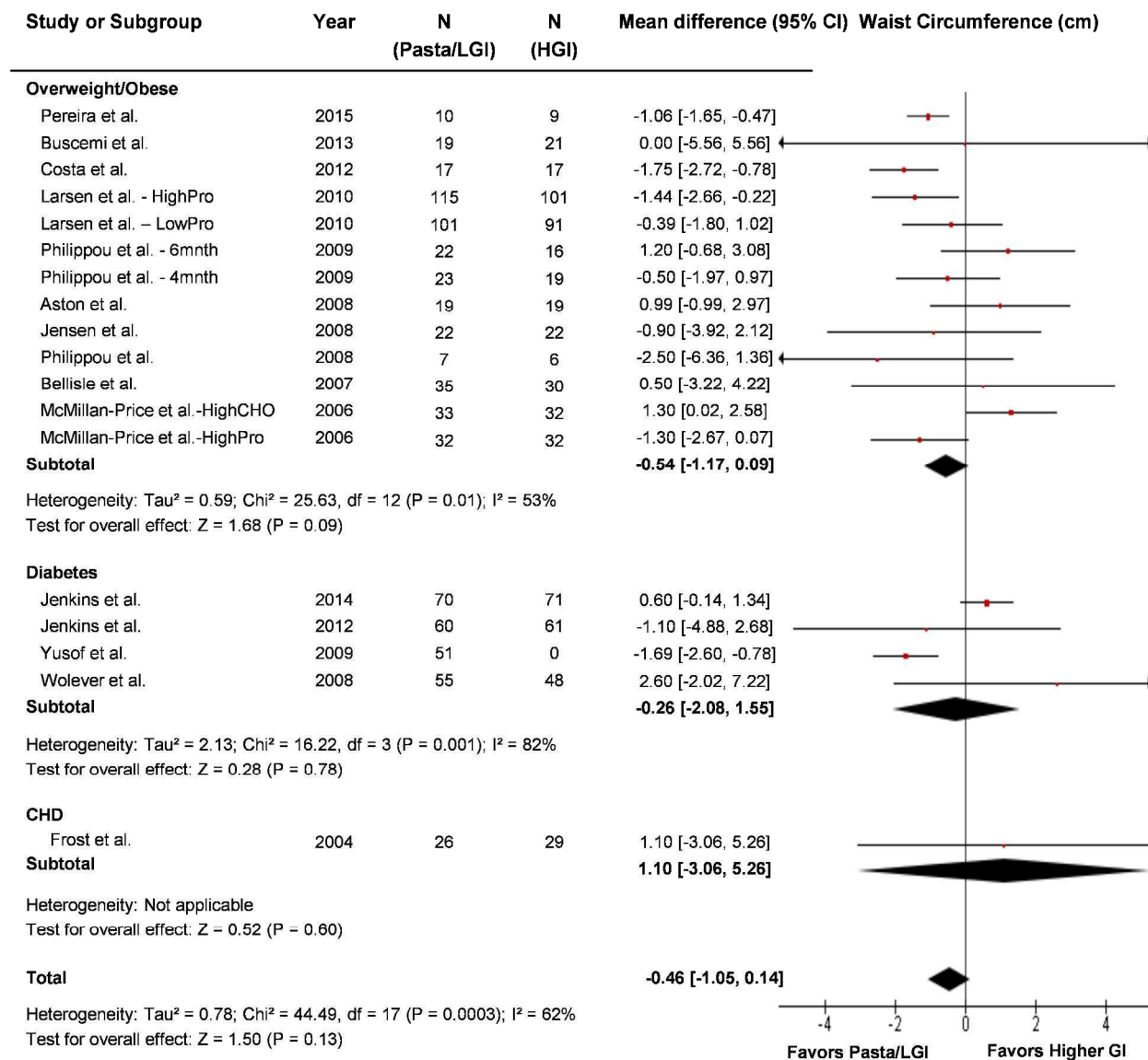
BMI, body mass index; CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S4: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body fat (%) (n= 285)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot’s bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran’s Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

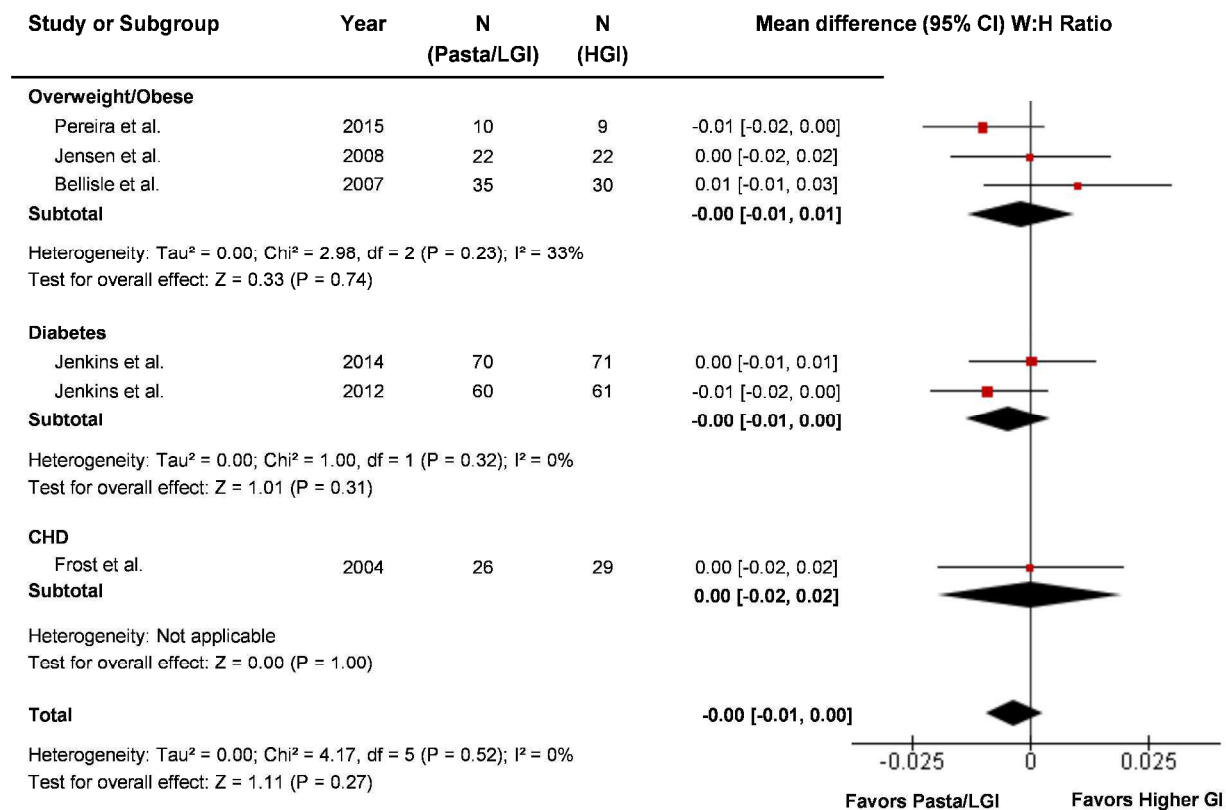
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S5: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

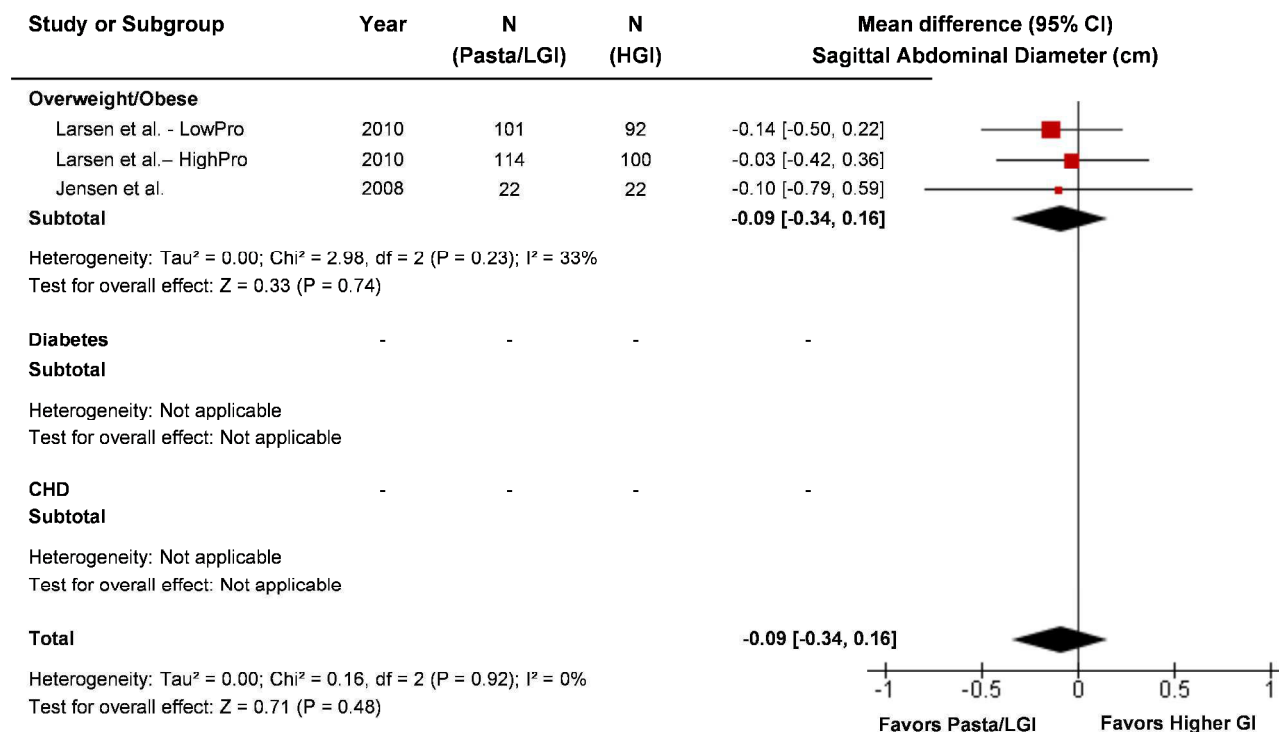
CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; Pro, protein



Supplemental Figure S6: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on waist-to-hip ratio (n = 445)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

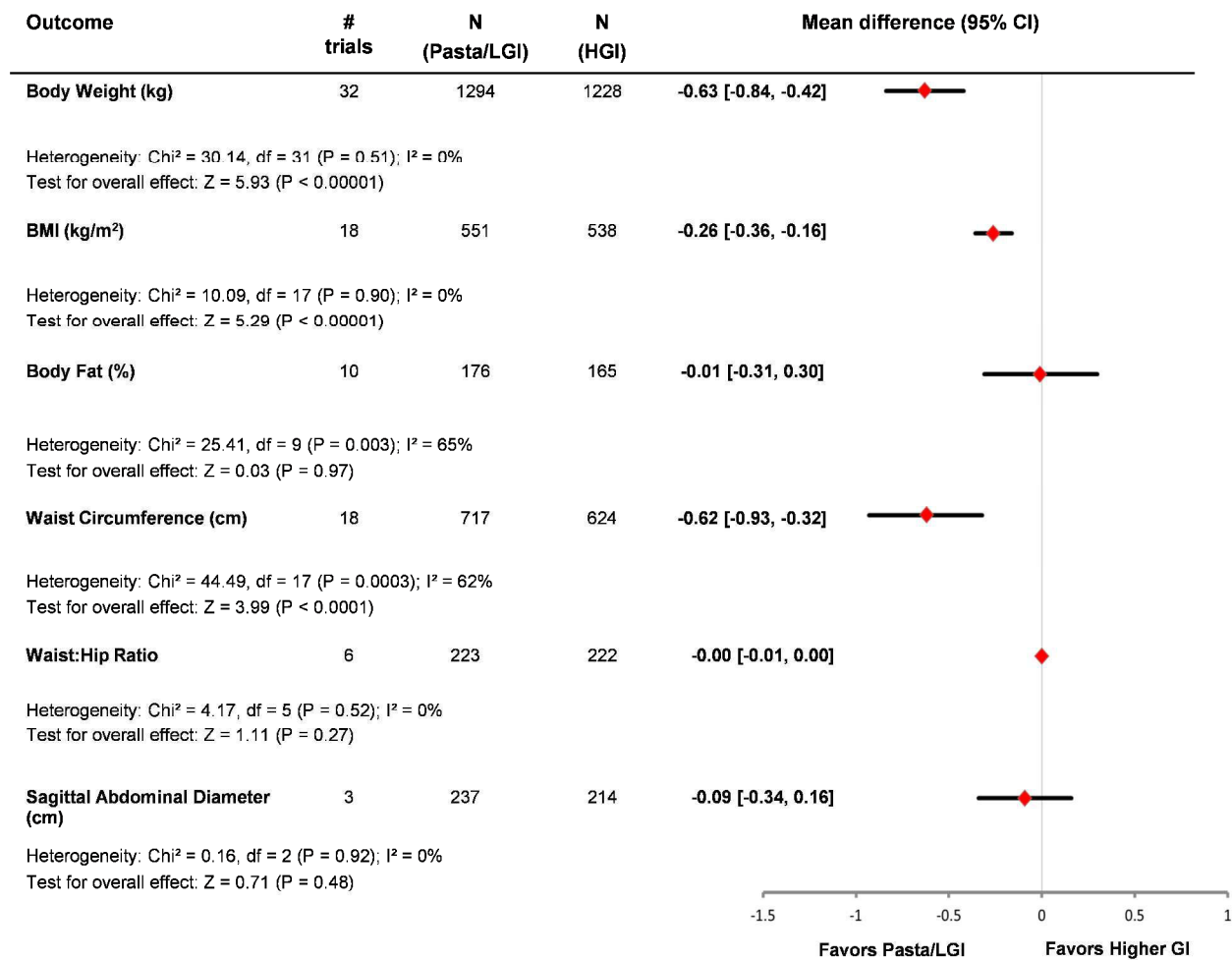
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S7: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on sagittal abdominal diameter (cm) (n = 478)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

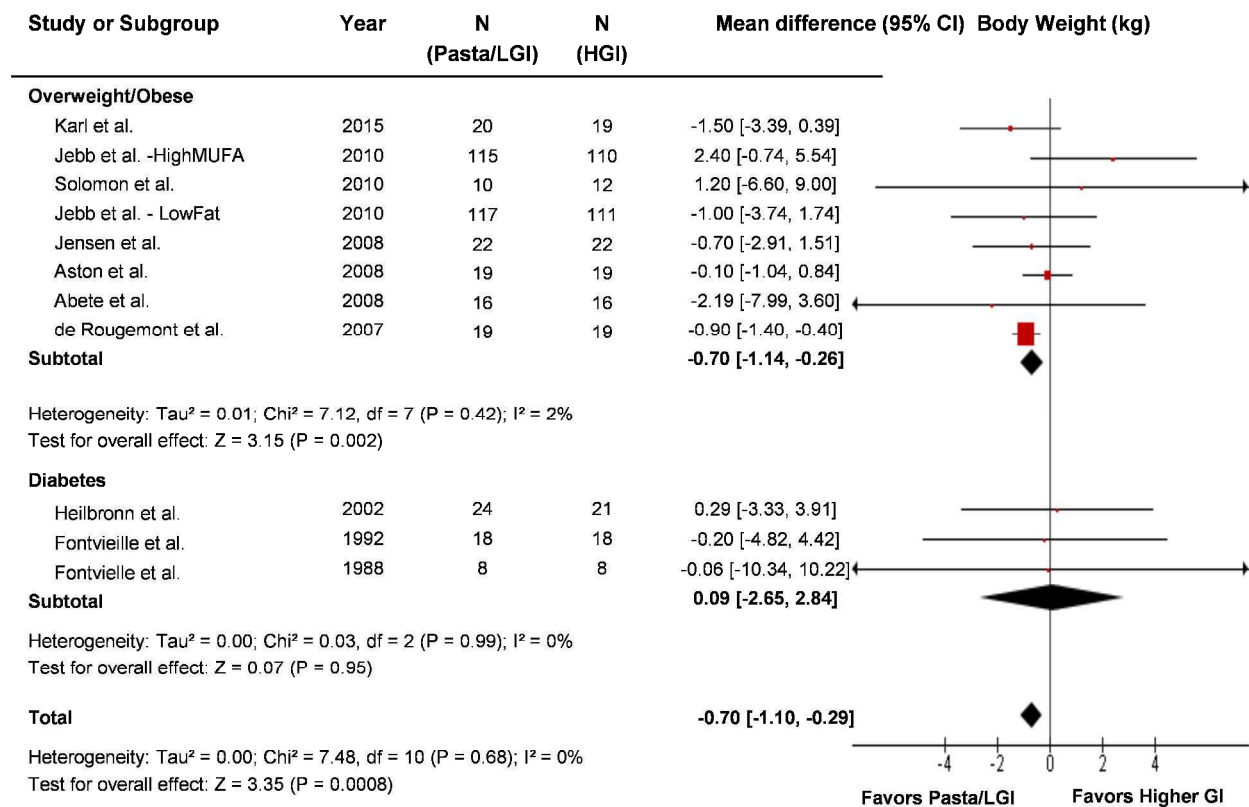
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; Pro, protein



Supplemental Figure S8: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg) using fixed effects models (n = 2448)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot’s bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance fixed effects models. Between-study heterogeneity was detected with the use of the Cochran’s Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

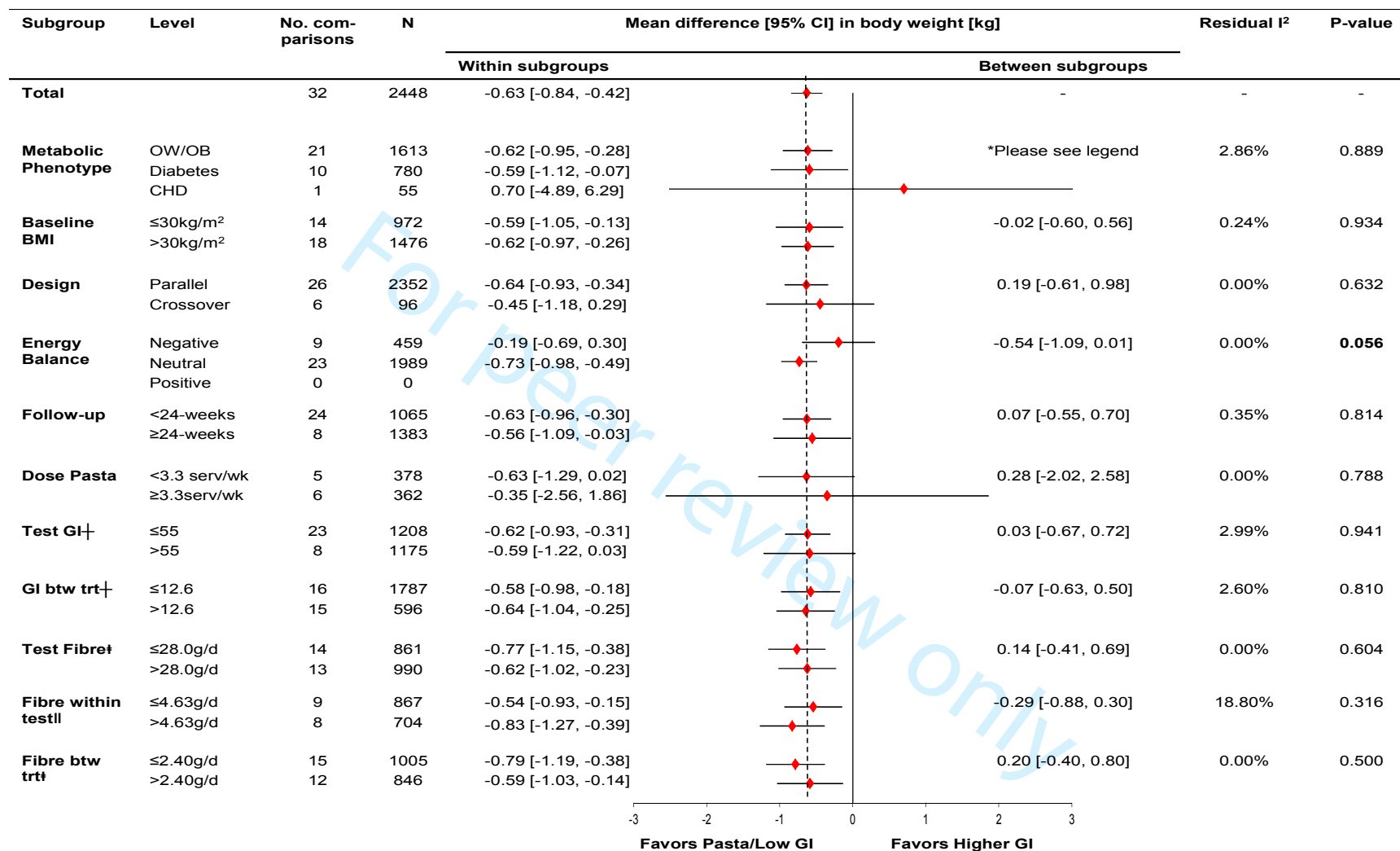
CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids; Pro, protein.



Supplemental Figure S9: Forest plot of randomized controlled trials which contain data for approximating pasta intake which are investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 740)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids



Supplemental Figure S10: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes.
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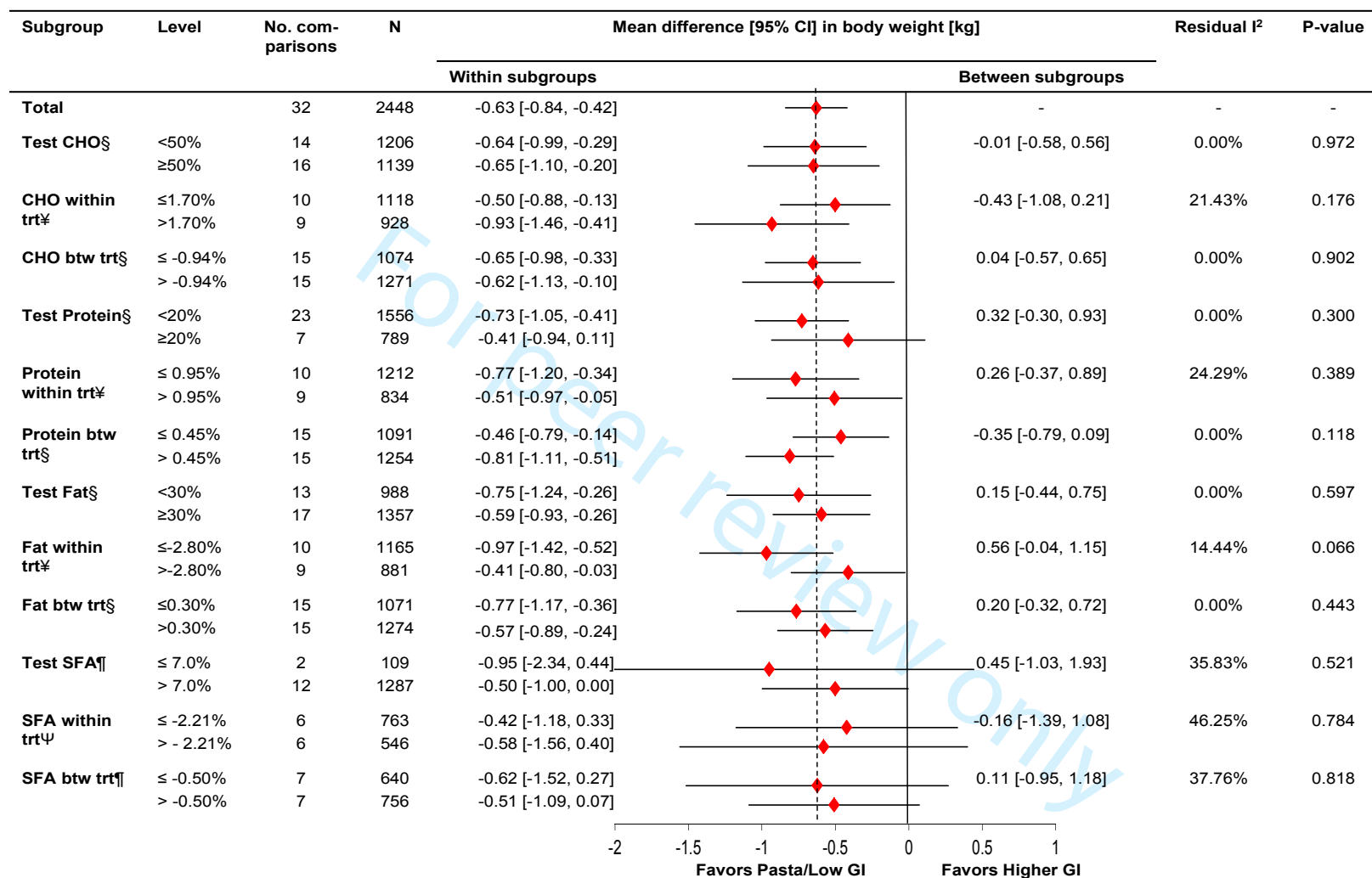
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11 BMI, body mass index; btw, between; CHD, coronary heart disease; CI, confidence interval; GI, glycemic index (glucose scale); OB,
12 obese; OW, overweight; serv, serving; trt, treatment; wk, week.
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15 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.02kg (-0.08, 0.65) (1 vs. 2) to
16 1.32kg (-4.28, 6.91) (1 vs. 3) to -1.29kg (-6.91, 4.32) (2 vs. 3).

17 † data available on 31 studies

18 ‖ data available on 17 studies

19 ‡ data available on 27 studies
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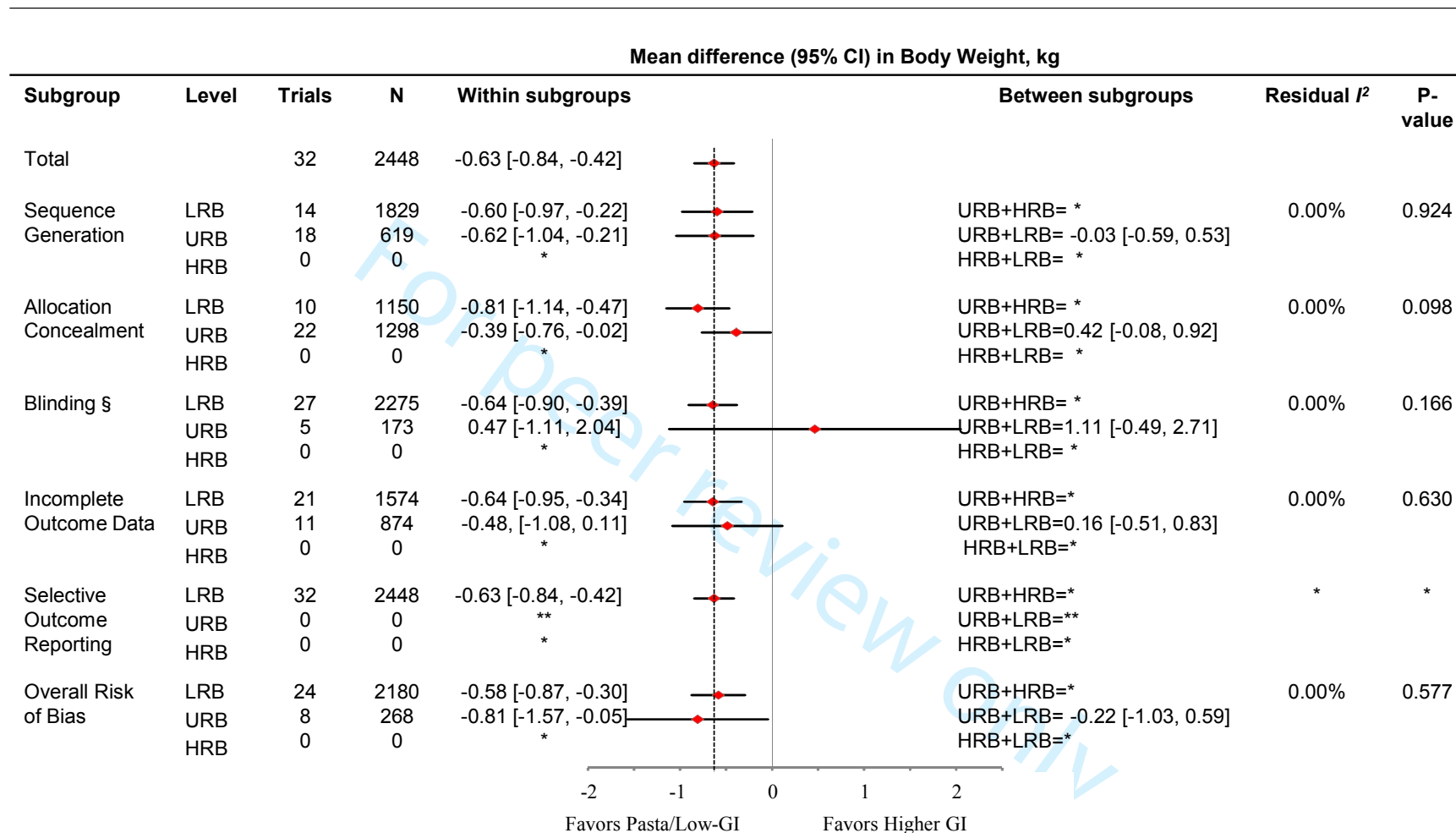
Supplemental Figure S11: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body weight (kg) continued (n = 2448)

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The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the median intakes.

BMI, body mass index; btw, between; CI, confidence interval; GI, glycemic index (glucose scale); trt, treatment.
§ data available on 30 studies
¥ data available on 19 studies
¶ data available on 14 studies
Ψ data available on 12 studies

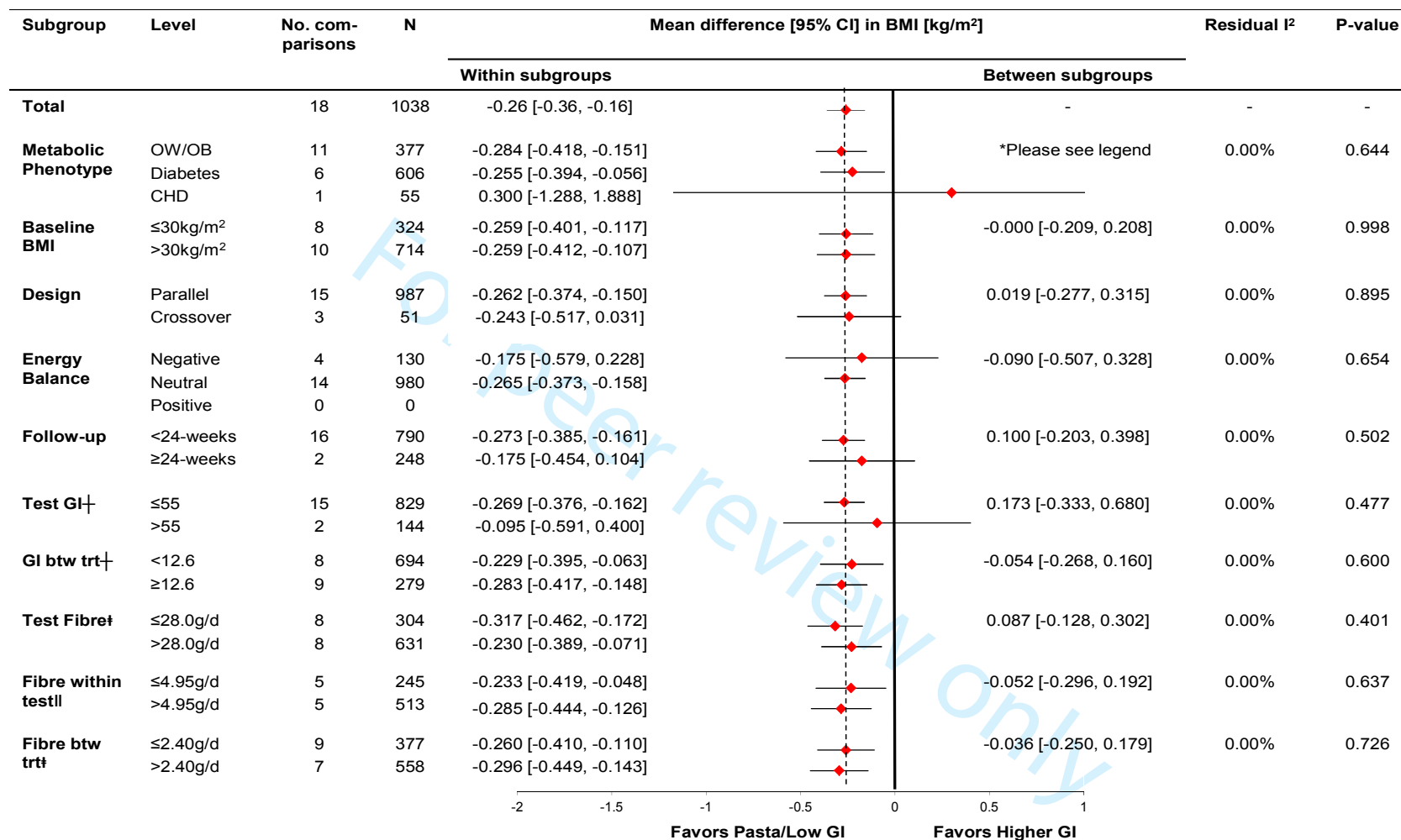
For peer review only



Supplemental Figure S12: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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10 LRB=Low Risk of Bias, URB= Unclear Risk of Bias, HRB=High Risk of Bias. *Within and between subgroup analysis could not be
11 performed against HRB since no values for HRB subgroup. ** no values for URB subgroup. § Blinding of Participants, Personnel,
12 and Outcome Assessors.
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Supplemental Figure S13: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) (n = 1038)

The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line through the square. The residual I² was estimated with the use of the Cochran’s Q statistic and indicates the between study

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3 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
4 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
5 median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=3 trials), therefore analyses
6 were not performed.
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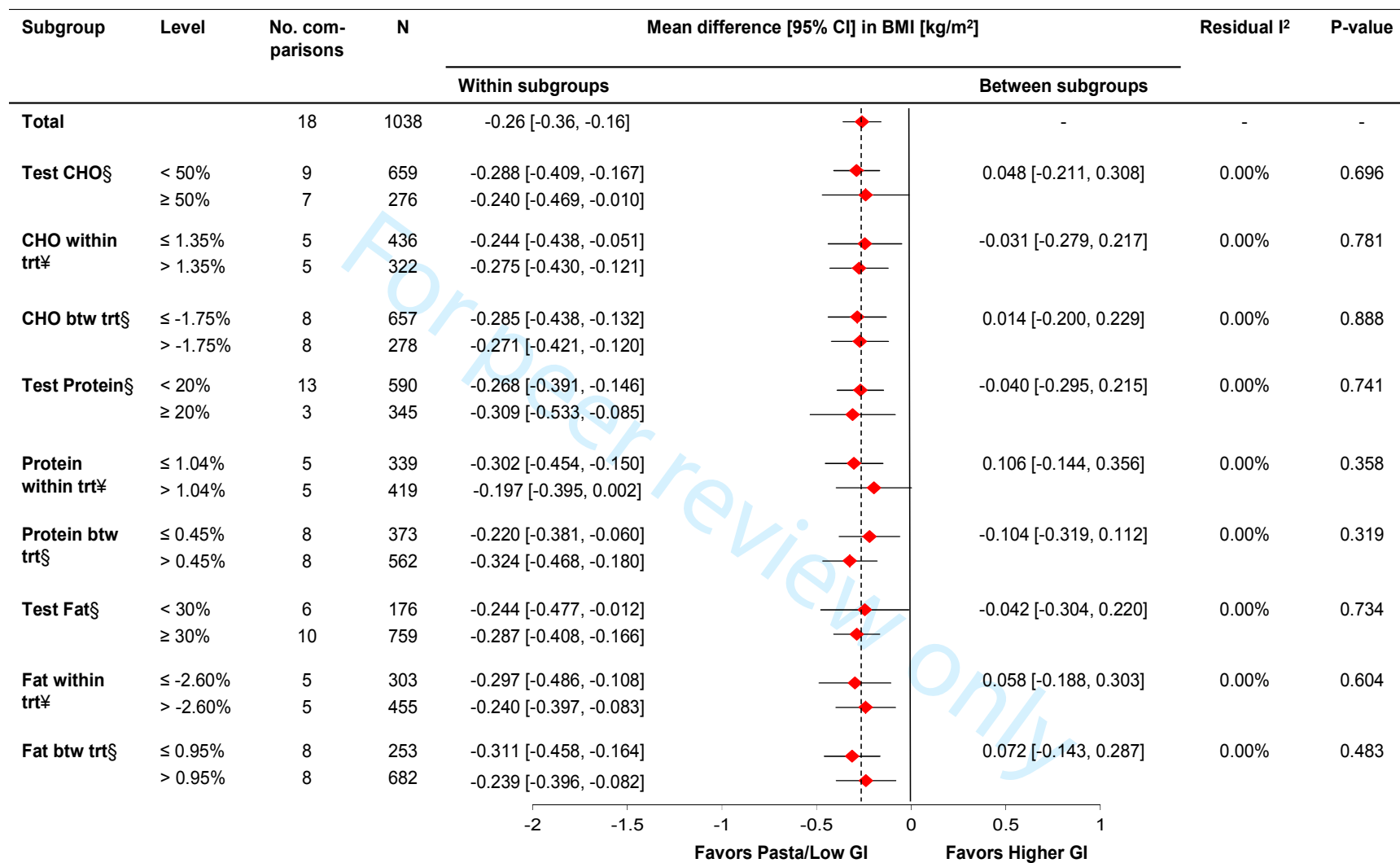
9 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.059kg/m^2 (-0.156, 0.274) (1 vs.
10 2) to 0.584kg/m^2 (-1.009, 2.178) (1 vs. 3) to -0.525kg/m^2 (-2.122, 1.072) (2 vs. 3).
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12 † data available on 17 studies

13 ‡ data available on 16 studies

14 § data available on 10 studies
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16 BMI, body mass index; btw, between; CI, confidence interval; GI, glycemic index (glucose scale); OB, obese; OW, overweight; trt,
17 treatment.
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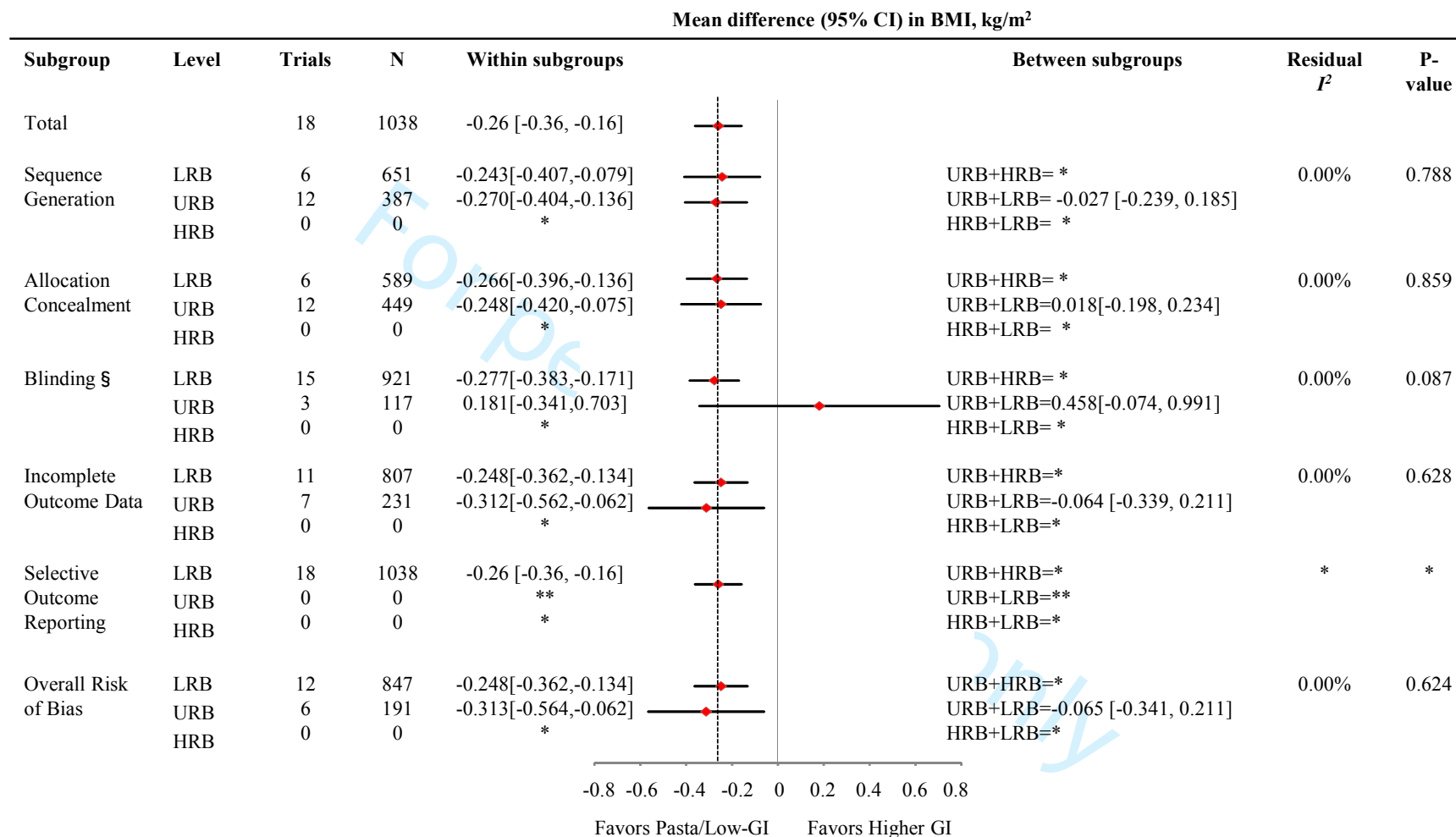
Supplemental Figure S14: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) continued (n = 1038)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line
5 through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes. There were less than 10 trials available for categorical subgroup assessment for test saturated fat (n=7 trials), saturated
9 fat within treatment (n=6 trials) and saturated fat between treatments (n=7 trials), therefore analyses were not performed.

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11 § data available on 16 studies

12 ¥ data available on 10 studies

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15 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); trt, treatment.



Supplemental Figure S15: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) (n = 1038)

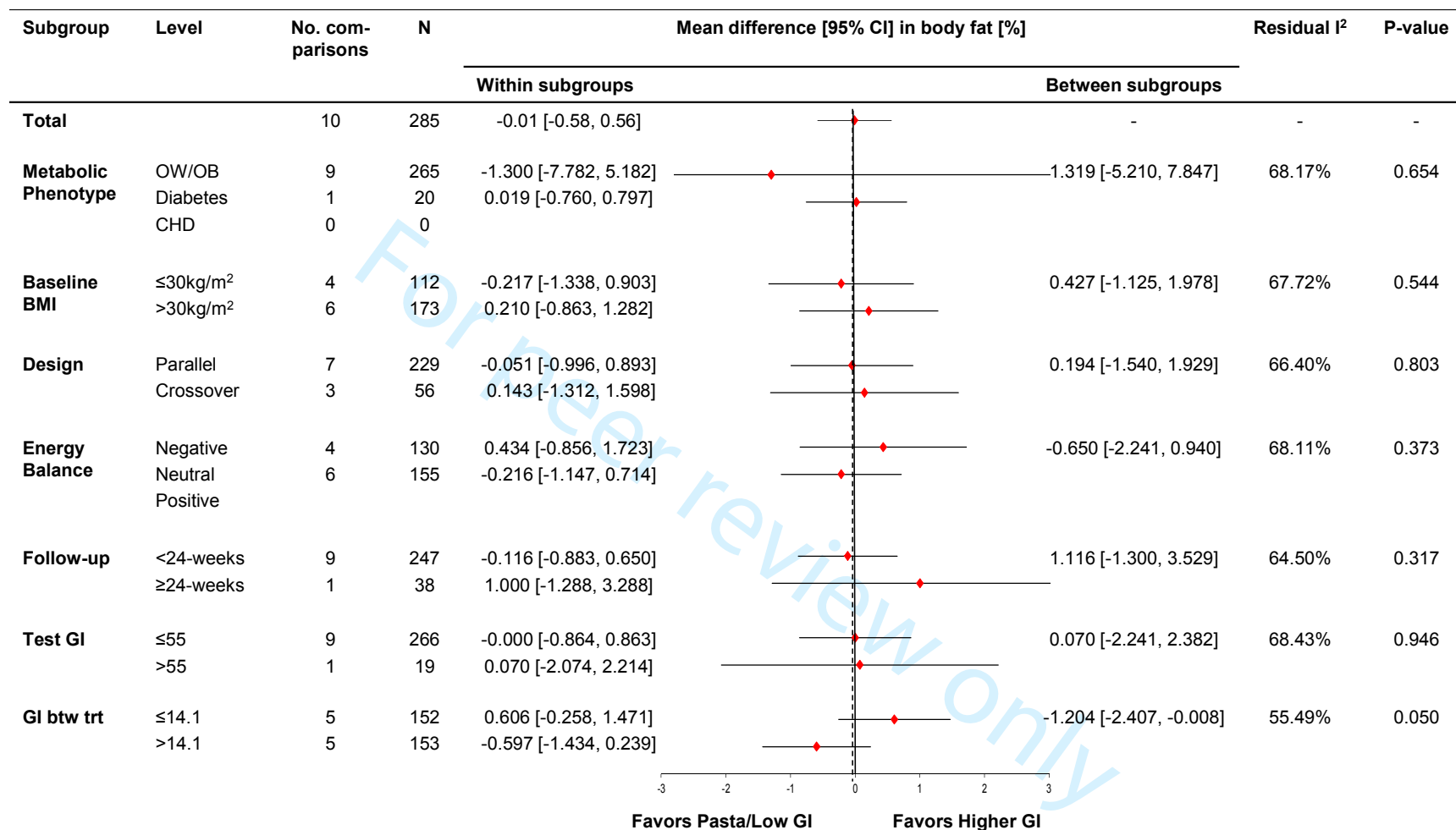
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line
5 through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.
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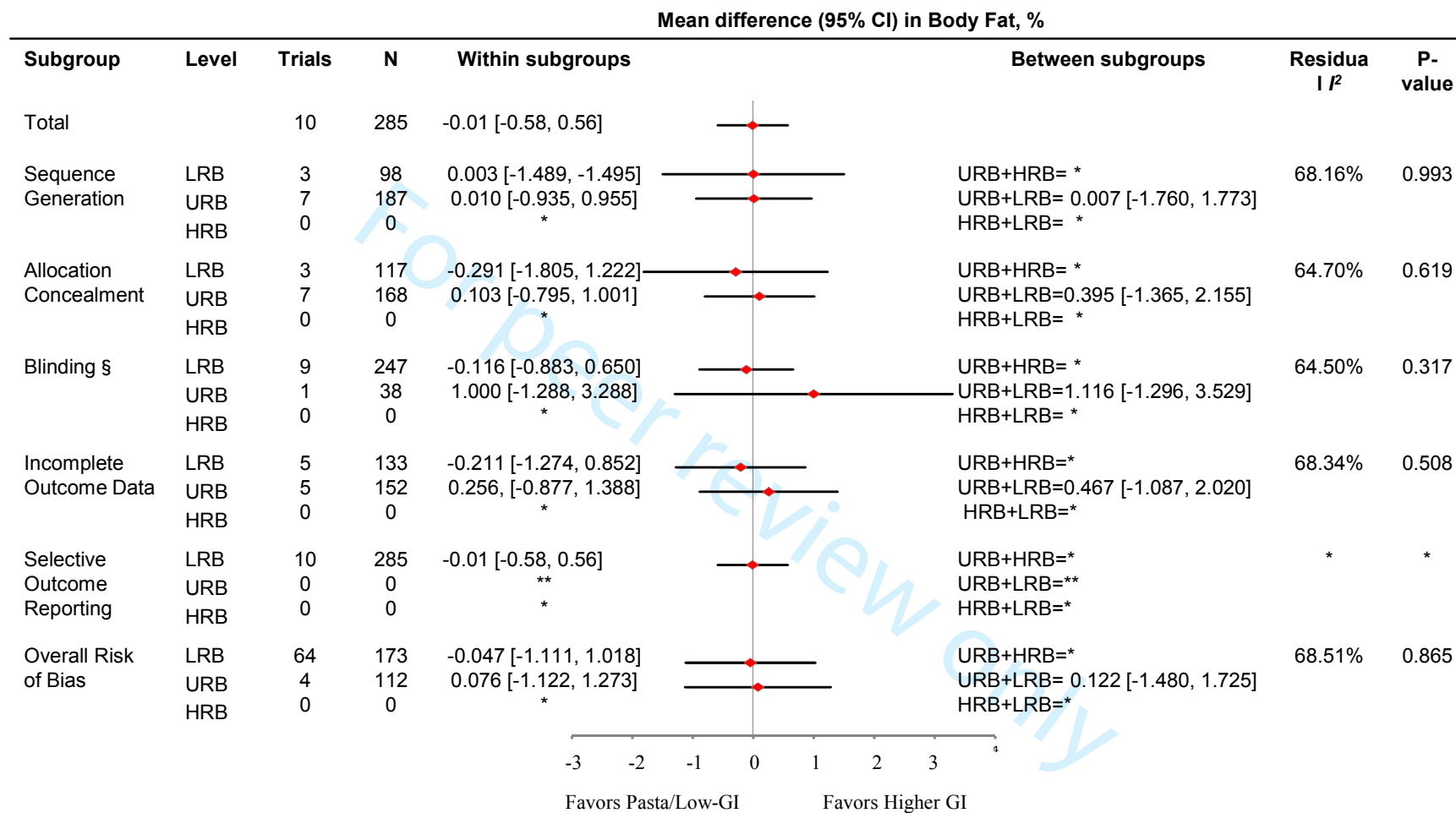
15 BMI, body mass index; CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear
16 Risk of Bias.
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Supplemental Figure S16: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body fat (%) (n = 285)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body fat. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the
5 line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=3), test carbohydrate, protein
9 and fat (n=9), carbohydrate, protein and fat within treatment (n=4), carbohydrate, protein and fat between treatment (n=9), test fibre
10 (n=8), fibre within treatment (n=4), fibre between treatment (n=8), test saturated fat (n=3 trials), saturated fat within treatment (n=2
11 trials) and saturated fat between treatments (n=3 trials), therefore analyses were not performed.
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16 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); OB, obese;
17 OW, overweight; trt, treatment.
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Supplemental Figure S17: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body fat (%) (n = 285)

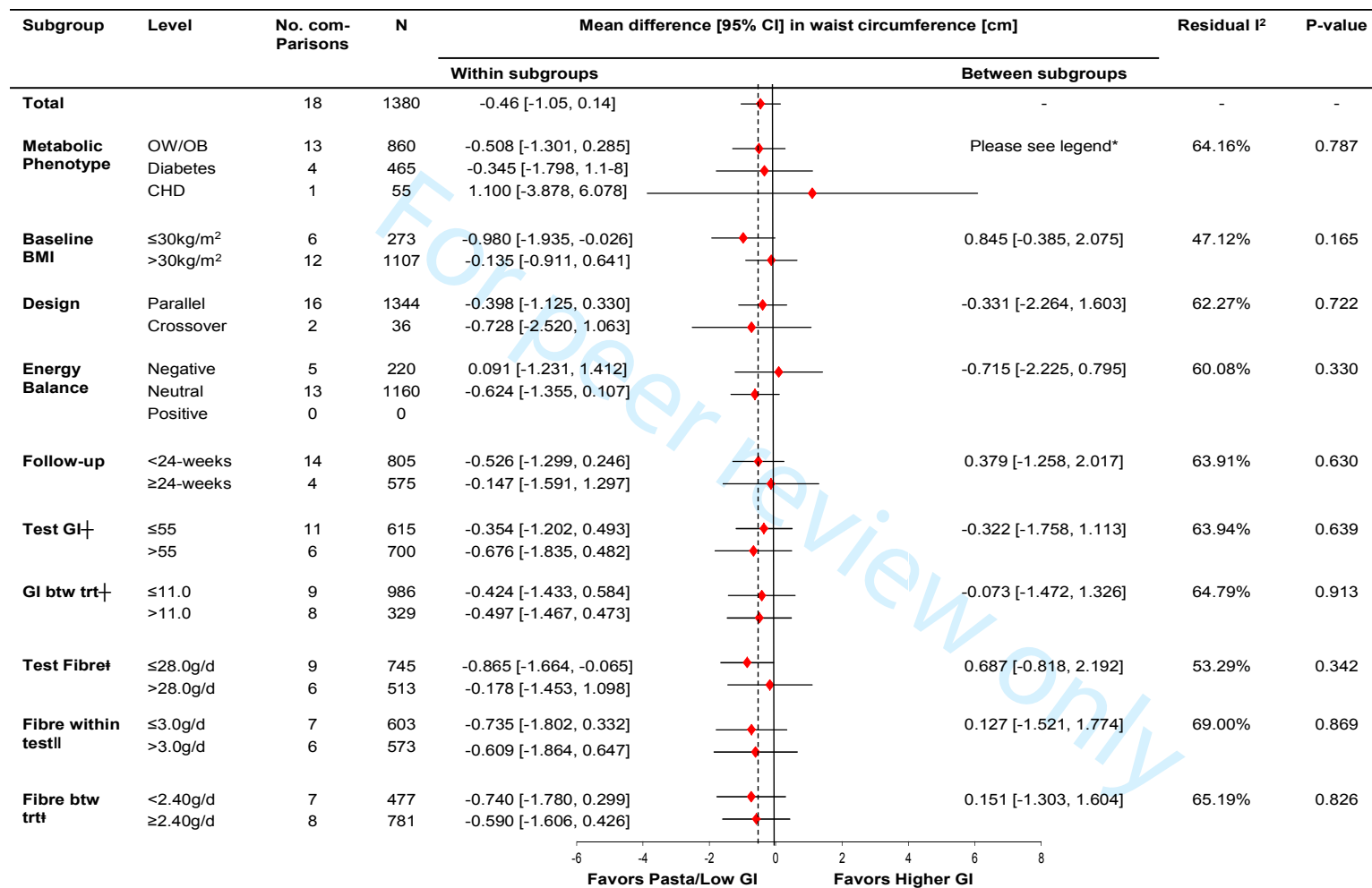
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body fat. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the
5 line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.

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15 CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear Risk of Bias
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Supplemental Figure S18: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

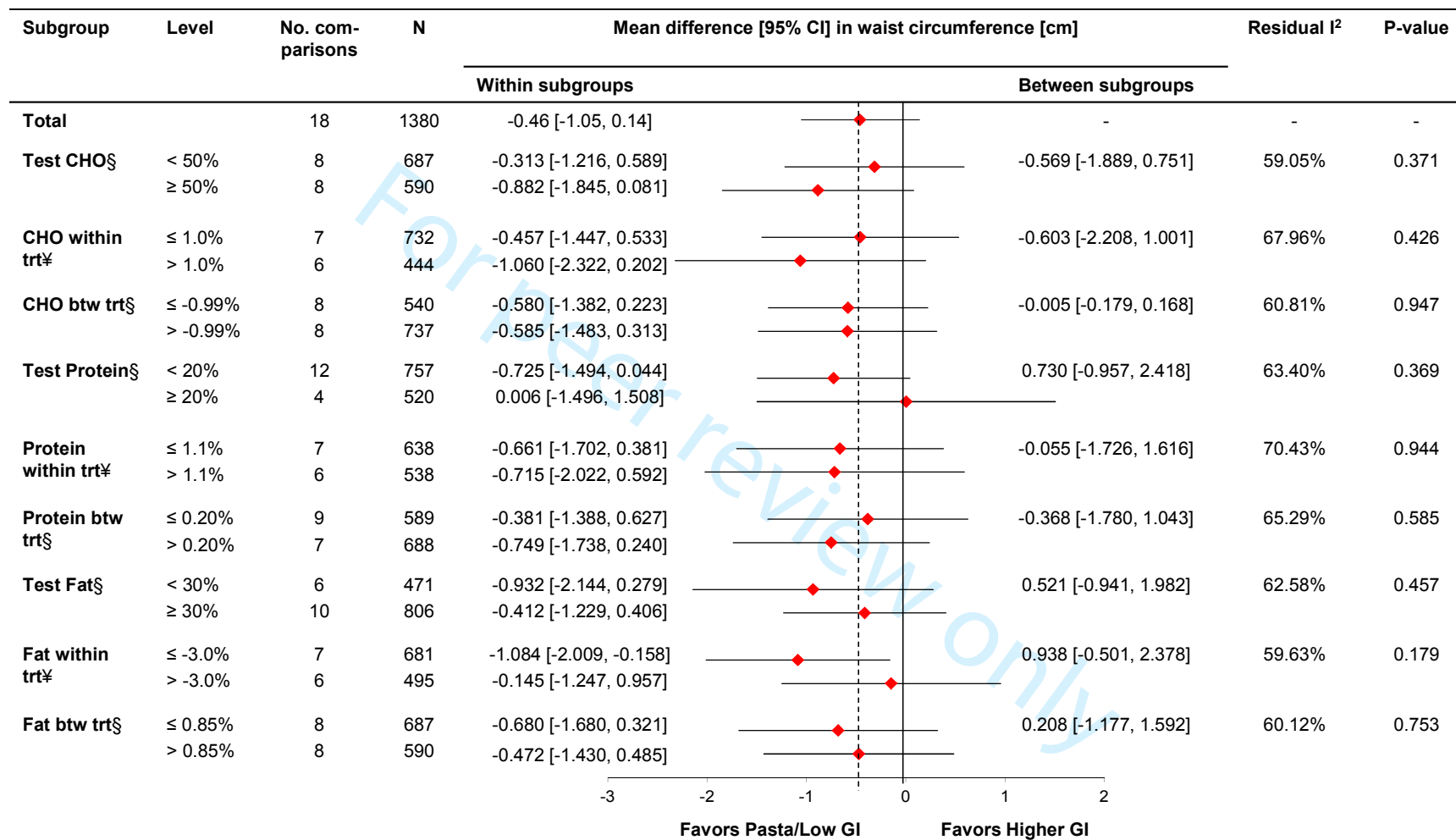
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup. Within and between-treatment changes were categorically
8 assessed based on the median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=2
9 trials), therefore analyses were not performed.
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12 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.163cm (-1.492, 1.818) (1 vs. 2)
13 to 1.608cm (-3.432, 6.648) (1 vs. 3) to -1.445cm (-6.630, 3.740) (2 vs. 3).

14 † data available on 17 studies

15 ‡ data available on 15 studies
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18 BMI, body mass index; btw, between; CI = confidence interval; GI, glycemic index (glucose scale); OB, obese; OW, overweight; trt,
19 treatment.
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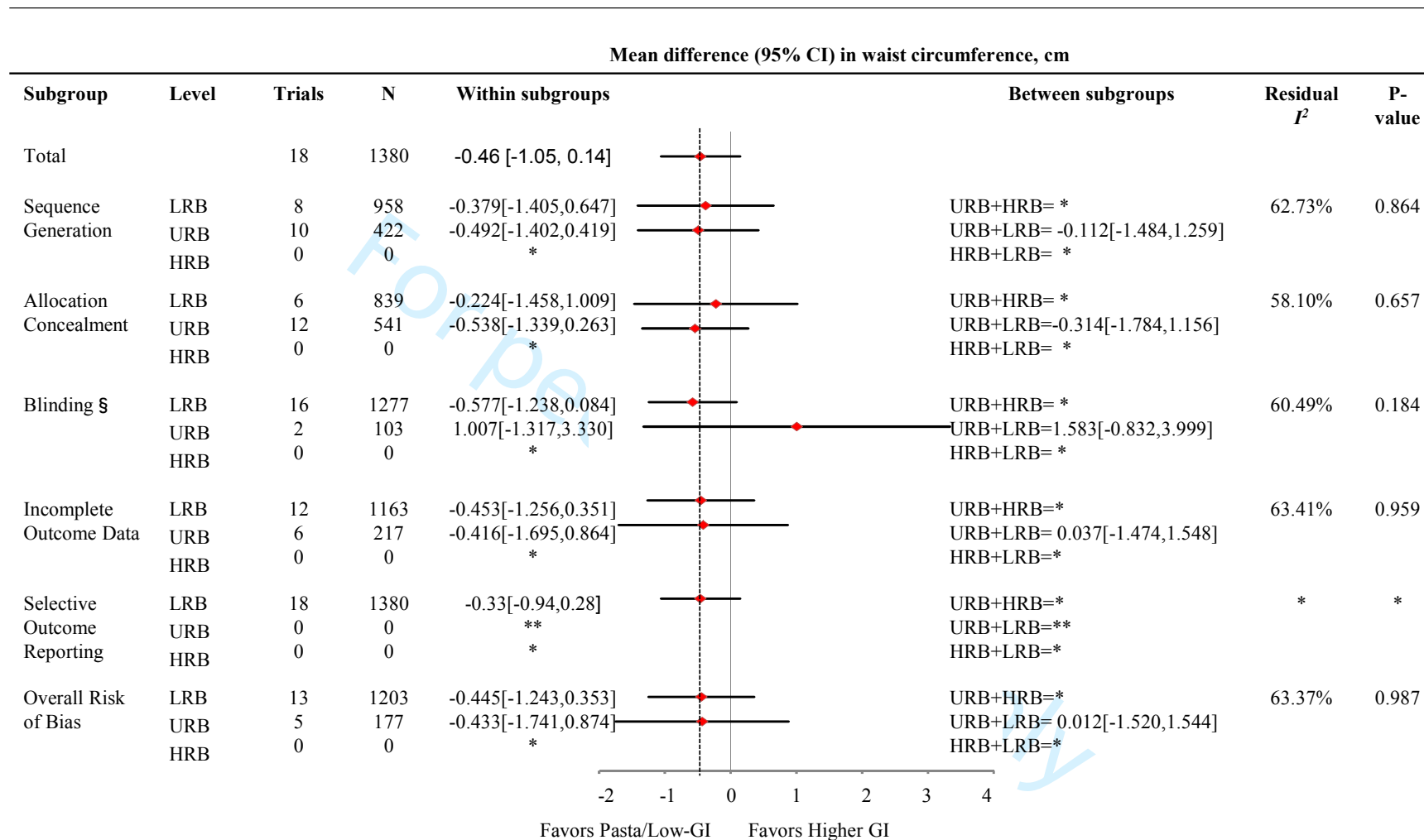
Supplemental Figure S19: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) continued (n = 1380)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup. Within and between-treatment changes were categorically
8 assessed based on the median intakes. There were less than 10 trials available for categorical subgroup assessment for test saturated fat
9 (n=8 trials), saturated fat within treatment (n=7 trials) and saturated fat between treatments (n=8 trials), therefore analyses were not
10 performed.
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13 § data available on 16 studies

14 ¥ data available on 13 studies

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17 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); trt, treatment.
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Supplemental Figure S20: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

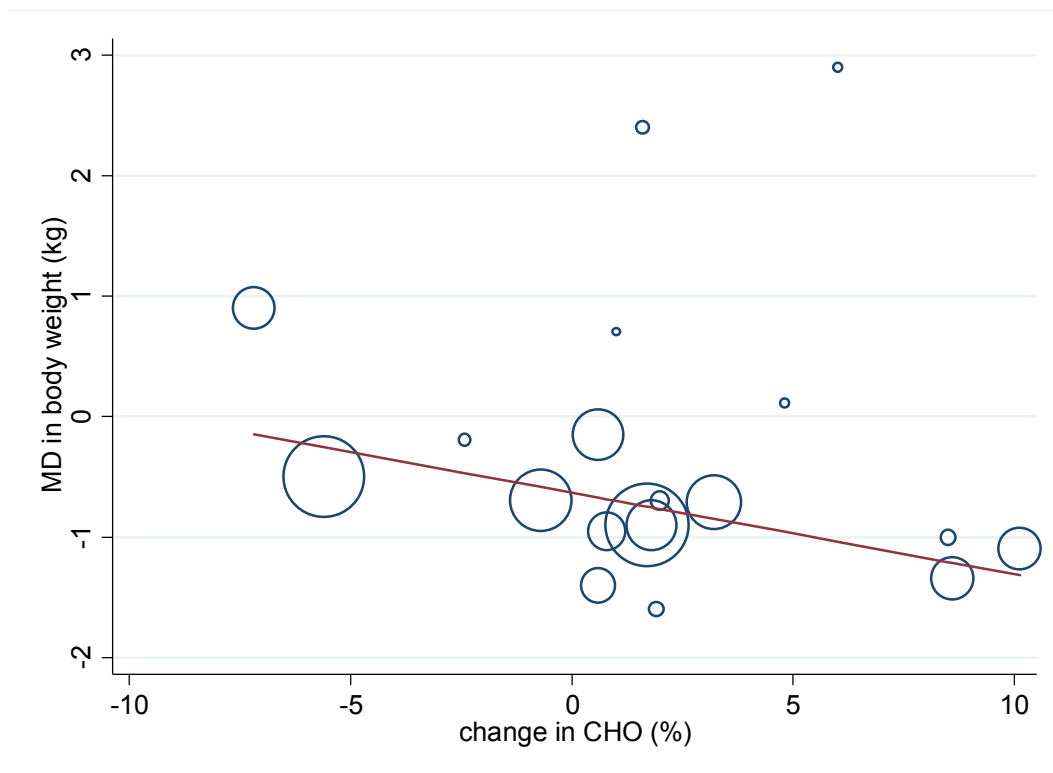
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup.
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10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.
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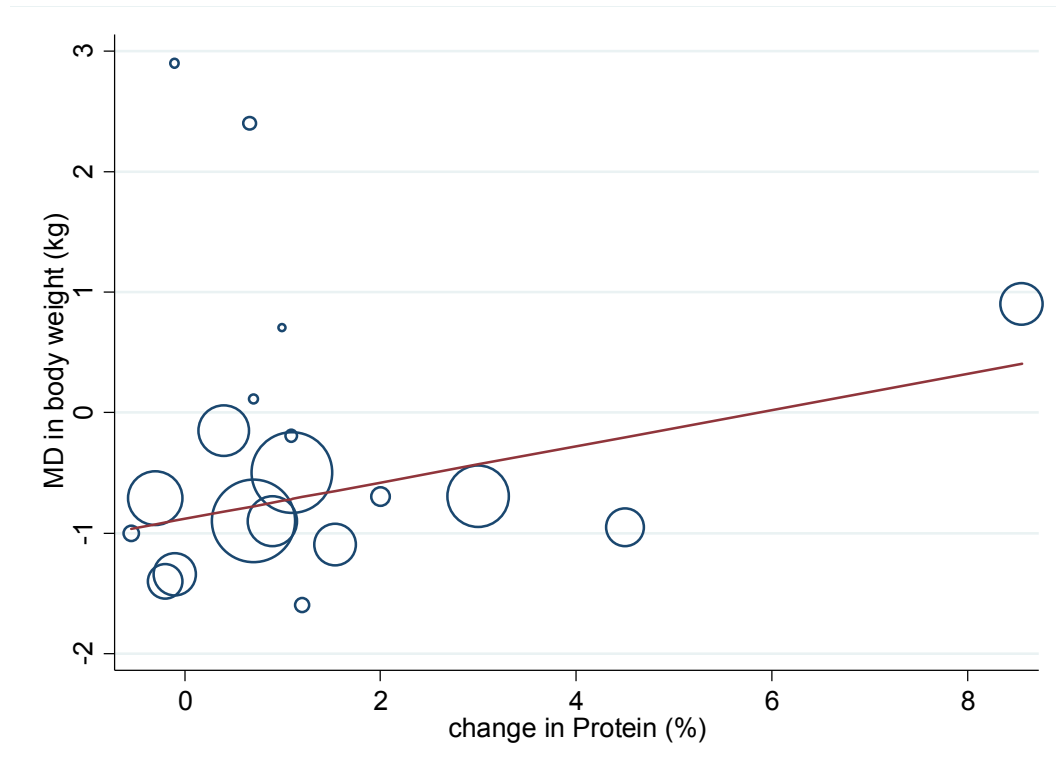
15 CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear Risk of Bias
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Supplemental Figure S21: Continuous meta-regression of change in carbohydrate intake in the low-GI dietary pattern intervention arms with change in body weight (n=19)

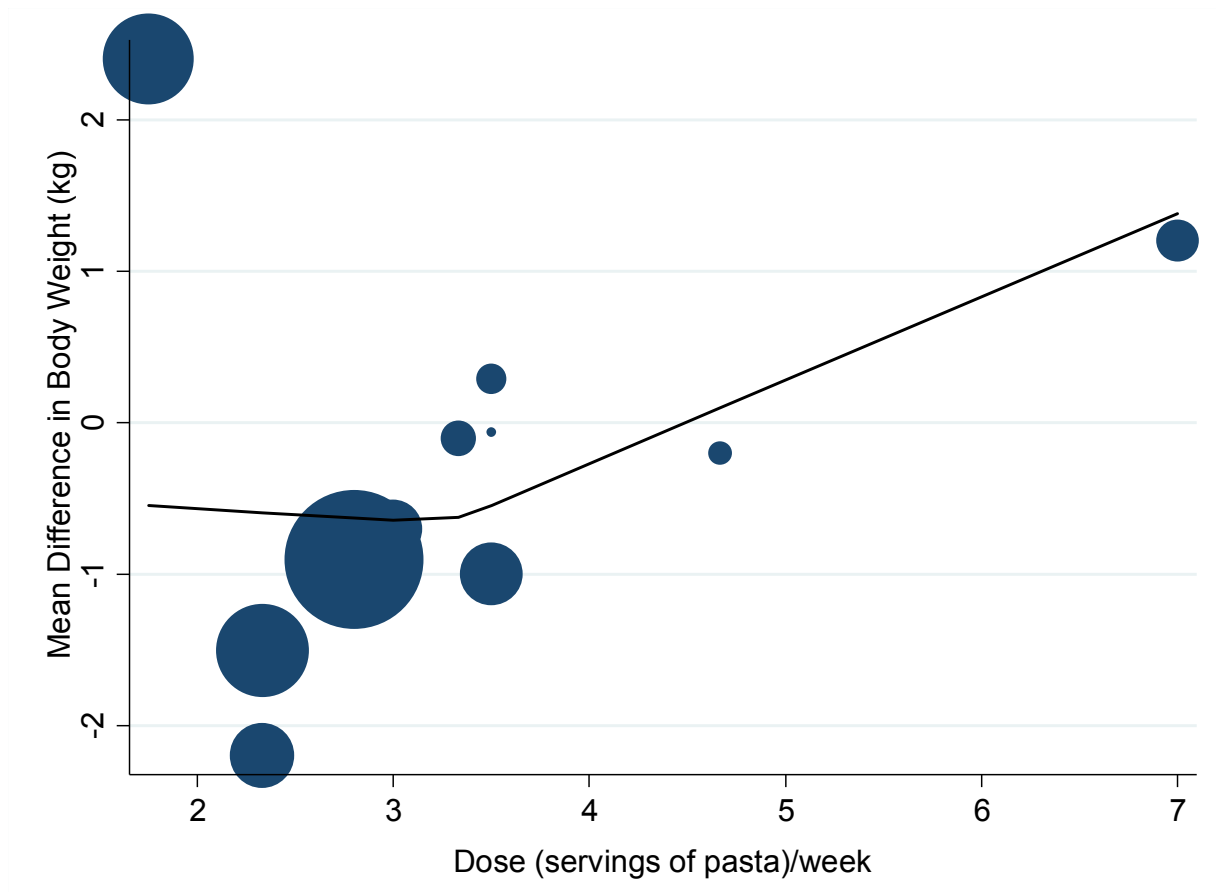
CHO, carbohydrate; MD, mean difference

review only

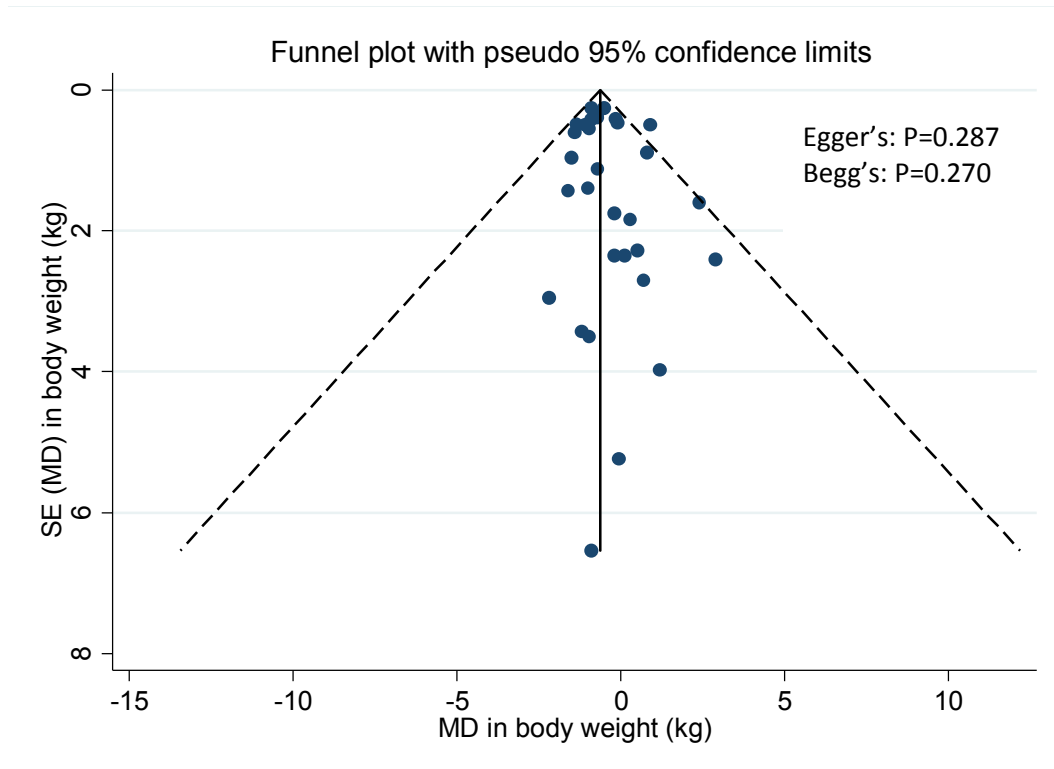


Supplemental Figure S22: Continuous meta-regression of change in protein intake in the low-GI dietary pattern intervention arms with change in body weight (n=19)

MD, mean difference

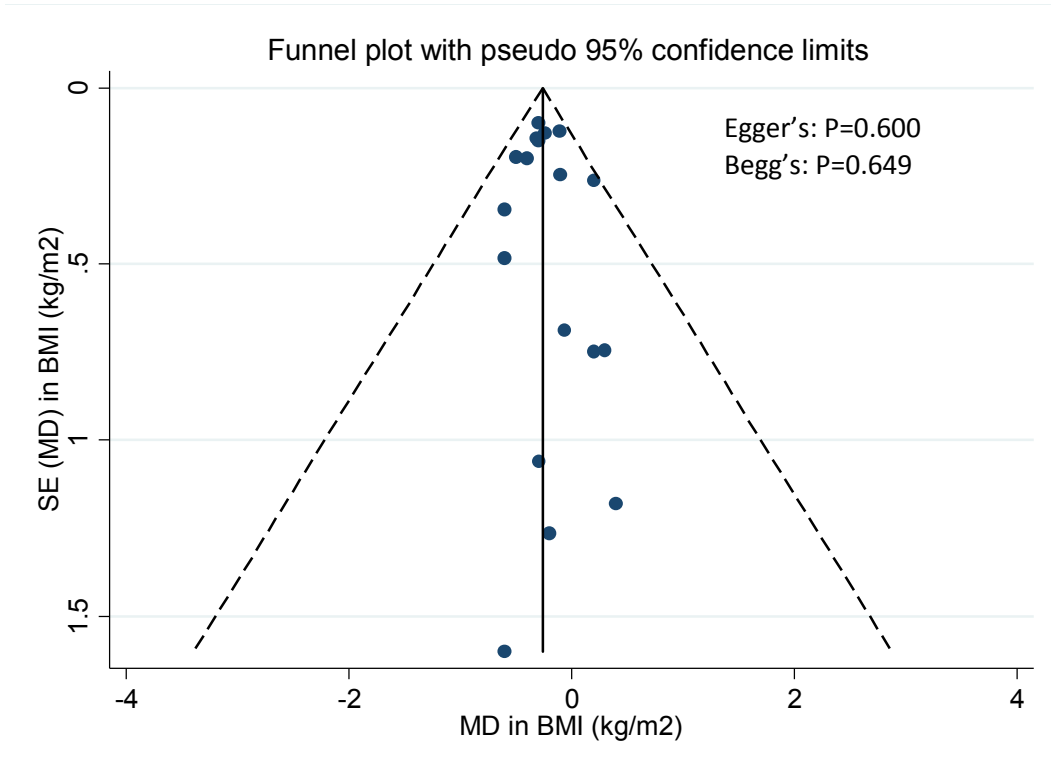


Supplemental Figure S23: Pasta intake dose-response analyses by spline curve modeling (MKSPLINE procedure)



Supplemental Figure S24: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on body weight (kg)

The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.

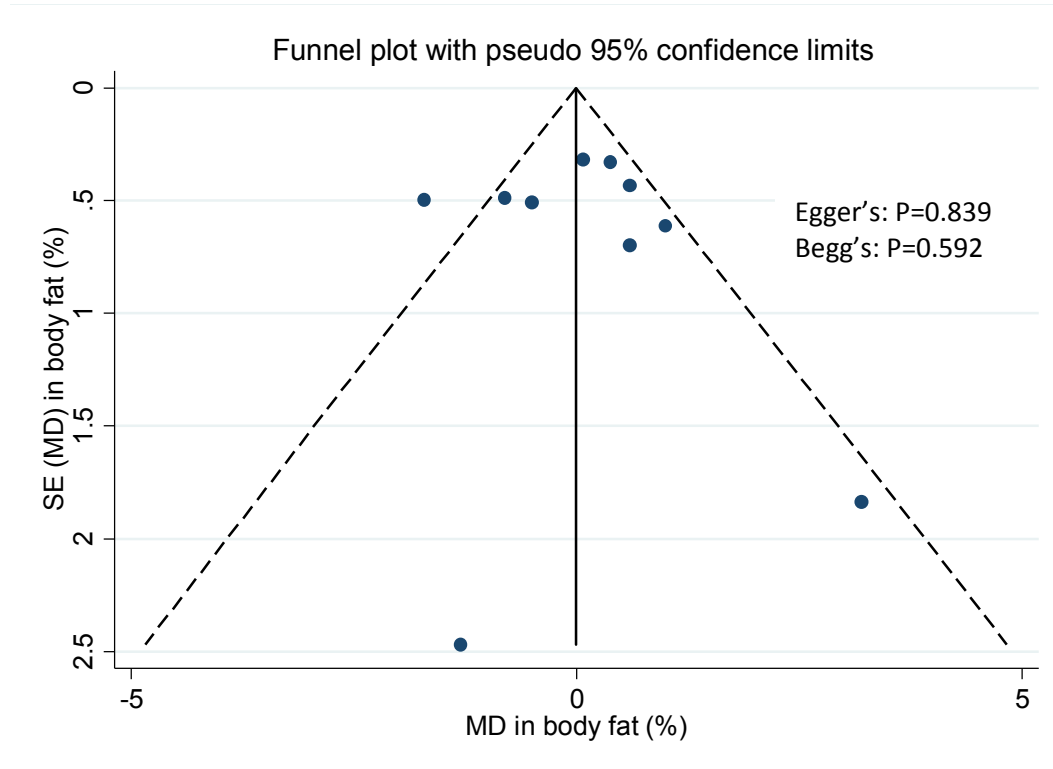


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Supplemental Figure S25: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on BMI (kg/m²)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.

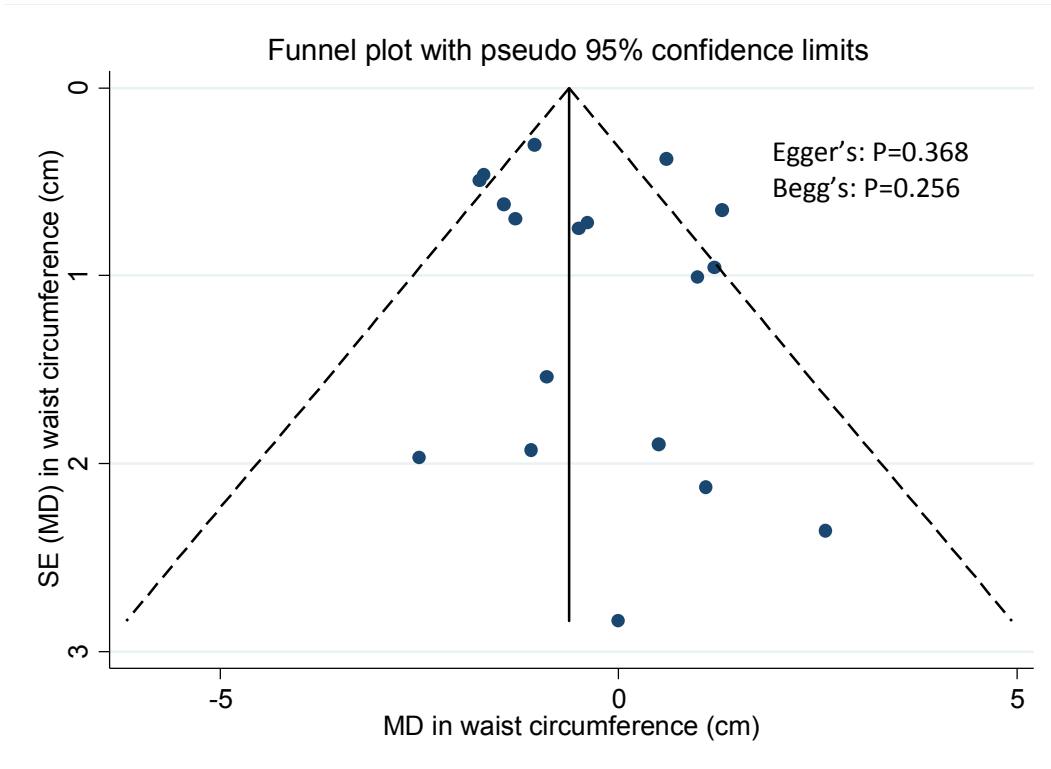


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Supplemental Figure S26: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on body fat (%)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.



29 **Supplemental Figure S27: Funnel plot for the effect of pasta in the context of low-GI**
30 **dietary patterns on waist circumference (cm)**

31 The solid line represents the overall pooled estimate for all studies included in the meta-analysis
32 expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived
33 from the quantitative assessment of publication bias by Egger's and Begg's tests.
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Supplemental Table S12: PRISMA Checklist



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-6, Supplemental Table S2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5, Supplemental Table S1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplemental Table S1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and	6, Supplemental

		simplifications made.	Table S2
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	7-9

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7-8
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9-11, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-11, Table 1, Supplemental Tables S2-S3
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	11, Supplemental Figures S1-S2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11-12, Figures 2-3, Supplemental Figures S3-S7
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	11-12, Figures 2-3, Supplemental Figures S3-S7
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15).	11, Supplemental

			Table S1, S2, S12, S15, S17, S20
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	12-15, Supplemental Tables S4-S10, Supplemental Figures S8-S26
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16-19
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	19-21
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	21-22
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	25-26

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

BMJ Open

Effect of Pasta in the Context of Low Glycemic Index Dietary Patterns on Body Weight and Markers of Adiposity: A Systematic Review and Meta-analysis of Randomized Controlled Trials in Adults

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-019438.R1
Article Type:	Research
Date Submitted by the Author:	08-Dec-2017
Complete List of Authors:	Chiavaroli, Laura; St. Michael's Hospital, Toronto 3D Knowledge Synthesis and Clinical Trials Unit; University of Toronto, Nutritional Sciences Kendall, Cyril; University of Toronto, Nutritional Sciences Braunstein, Catherine; University of Toronto, Nutritional Sciences; St. Michael's Hospital, Toronto 3D Knowledge Synthesis and Clinical Trials Unit Blanco Mejia, Sonia; Clinical Nutrition and Risk Factor Modification Centre, St. Michael's Hospital; Toronto 3D Knowledge Synthesis and Clinical Trials Unit, St. Michael's Hospital Leiter, Lawrence; St. Michael's Hospital, Endocrinology; University of Toronto, Nutritional Sciences Jenkins, David; St. Michael's Hospital, Clinical Nutrition and Risk Factor Modification Center; University of Toronto, Nutritional Sciences Sievenpiper, John; McMaster University, Department of Pathology and Molecular Medicine; St. Michael's Hospital, Clinical Nutrition and Risk Factor Modification Centre
Primary Subject Heading:	Nutrition and metabolism
Secondary Subject Heading:	Cardiovascular medicine
Keywords:	body weight, pasta, glycemic index, glycaemic index, systematic review and meta-analysis, weight loss

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Manuscripts

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3 **1 Effect of Pasta in the Context of Low Glycemic Index Dietary Patterns on Body Weight**
4 **2 and Markers of Adiposity: A Systematic Review and Meta-analysis of Randomized**
5 **3 Controlled Trials in Adults**

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8 4 Laura Chiavaroli^{1,2}, Cyril WC Kendall^{1,2,3}, Catherine R Braunstein^{1,2}, Sonia Blanco Mejia^{1,2},
9 5 Lawrence A Leiter^{1,2,4-6}, David JA Jenkins^{1,2,4-6}, John L Sievenpiper^{1,2,4-6}

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13 7 2 Toronto 3D Knowledge Synthesis and Clinical Trials Unit, St. Michael's Hospital, Toronto,
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49 25 analysis, weight loss

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3 **29 ABSTRACT**
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5 **30 Objective:** Carbohydrates have been implicated in the obesity epidemic. To assess the effect of
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8 **31** pasta alone or pasta in the context of low glycemic index (GI) dietary patterns on adiposity, we
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10 **32** conducted a systematic review and meta-analysis.
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13 **33**
14 **34 Design:** Systematic review and meta-analysis of randomized controlled trials (RCTs) with
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17 **35** GRADE assessment.
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19 **36**
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21 **37 Eligibility criteria for selecting studies:** MEDLINE, Embase, CINAHL, and the Cochrane
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24 **38** Library were searched through 07 February 2017. We included RCTs ≥ 3 -weeks assessing the
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26 **39** effect of pasta alone or in the context of low-GI dietary patterns on measures of global (body
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28 **40** weight, BMI, body fat) and regional (waist circumference [WC], waist-to-hip ratio [WHR],
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30 **41** sagittal abdominal diameter [SAD]) adiposity in adults. Two independent reviewers extracted
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32 **42** data and assessed risk of bias. Data were pooled using the generic inverse-variance method and
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34 **43** expressed as mean differences (MDs) with 95% confidence intervals (95% CIs). Heterogeneity
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36 **44** was assessed (Cochran Q statistic) and quantified (I^2 -statistic). GRADE assessed the overall
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38 **45** certainty of the evidence.
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44 **47 Results:** We identified no trials of the effect of pasta alone and 32 trial comparisons (n=2,448
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46 **48** participants) of the effect of pasta in the context of low-GI dietary patterns. Pasta in the context
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48 **49** of low-GI dietary patterns significantly reduced body weight (MD=-0.63kg [95% CIs, -0.84, -
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50 **50** 0.42kg]) and BMI (MD=-0.26kg/m² [95% CIs, -0.36, -0.16kg/m²]) compared with higher-GI
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52 **51** dietary patterns. There was no effect on other measures of adiposity. The overall certainty of the
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3 52 evidence was graded as moderate for body weight, BMI, WHR, and SAD and low for WC and
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5 53 body fat.
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10 55 **Conclusions:** Available RCTs demonstrate that pasta in the context of low-GI dietary patterns
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12 56 does not adversely affect adiposity and even reduces body weight and BMI compared to higher
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14 57 GI dietary patterns. Future trials should assess the effect of pasta in the context of other healthy
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16 58 dietary patterns.
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21 60 **Protocol registration:** ClinicalTrials.gov Identifier, NCT02961088
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28 63 **Strengths and limitations of this study**
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31 64 - The present systematic review and meta-analysis was based on a comprehensive search
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33 65 and includes a large number of randomized controlled trials which provide the best
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35 66 protection against bias.
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38 67 - We used the Grading of Recommendations Assessment, Development, and Evaluation
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40 68 (GRADE) system to evaluate the strength and quality of the evidence.
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42 69 - There was evidence of unexplained inconsistency in the intervention estimates across
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44 70 trials for waist circumference and body fat.
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47 71 - The generalizability of our results is questionable with evidence of indirectness in the
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49 72 pooled estimates for all body and adiposity outcomes, as all of the trials assessed pasta in
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51 73 the context of low-GI dietary patterns (no trials assessed the effect of pasta alone or in the
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3 74 context of other dietary patterns) and most of the available trials did not quantify the
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5 75 amount of pasta consumed.
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For peer review only

INTRODUCTION

As the role of saturated fat in chronic disease has been called into question, carbohydrates have come under attack in the media^{1,2}, popular books³⁻⁹, statements of health advocacy groups¹⁰ and commentaries in leading medical journals^{11,12}. Much of the attention has focused on sugars but traditional carbohydrate staples like pasta, rice, and breads are increasingly being implicated in the epidemics of overweight and obesity^{1,7}. Although advantages for weight related outcomes have been shown for dietary patterns that are high in these foods but low in glycemic index (GI)^{13,14}, high in whole grains^{15,16}, and/or high in dietary fibre^{17,18}, there has been a general lack of recognition of the importance of carbohydrate quality.

Pasta is an important example of a food which is considered a refined carbohydrate but has a low-GI, a property that has been exploited extensively in studies of low-GI dietary patterns. It remains unclear whether pasta alone or in the context of a low-GI dietary pattern contributes to weight gain^{1,7}. We undertook a systematic review and meta-analysis of randomized controlled trials (RCTs) with a full GRADE assessment to quantify the effect of pasta alone or in the context of low-GI dietary patterns on body weight and measures of adiposity relevant to the prevention and management of overweight and obesity.

METHODS

Design

Our protocol followed the guideline of the Cochrane Handbook for Systematic Reviews of Interventions¹⁹, and findings are reported according to the guidelines of the Preferred Reporting

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3 98 Items for Systematic Reviews and Meta-Analyses²⁰ (**Supplemental Table S1**). The protocol is
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5 99 registered at clinicaltrials.gov (identifier, NCT02961088).
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101 **Data sources and searches**

102 We searched MEDLINE (<http://www.nlm.nih.gov/bsd/pmresources.html>), Embase
103 (<https://www.embase.com>), CINAHL (<https://health.ebsco.com/products/the-cinahl-database>),
104 and the Cochrane Library (<http://www.cochranelibrary.com/>) from inception through 07
105 February 2017. The full search terms used in this study are presented in **Supplemental Tables**
106 **S2-S3**. Briefly, we searched using variations of the terms pasta and glycemic index and glycemic
107 load and body weight and BMI. The search was limited to human studies and had no language
108 restrictions. Reference lists of selected studies and reviews were also searched to identify
109 additional articles.
110

111 **Study selection**

112 We include RCTs that investigated the effect of pasta consumed alone or in the context of low-
113 GI dietary patterns that emphasized pasta in comparison with higher GI diets that did not include
114 pasta on body weight or other measures of global (BMI, body fat) or abdominal (waist
115 circumference, waist-to-hip ratio, sagittal abdominal diameter, or visceral adipose tissue assessed
116 by imaging modalities) adiposity in participants of all health backgrounds. Trials were included
117 if the intervention arm assessed the effect of pasta consumed alone or assessed the effect of a low
118 GI diet which emphasized pasta as part of the low GI dietary advice. Trials were excluded if they
119 had diet duration of <3 weeks, did not intend to use a calorie- and macronutrient-matched
120 comparator arm that was higher in GI; included pregnant or breast-feeding women or children; or

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3 121 did not provide suitable end-point data. When multiple publications existed for the same study,
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5 122 the article with the most information was included (n=6). Published abstracts were not included.
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10 124 **Data extraction**

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12 125 Two reviewers (LC, CB) assessed the titles and abstracts of all identified studies and
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14 126 independently reviewed and extracted relevant data from each report, including study design,
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16 127 blinding, sample size, participant characteristics, follow-up duration, identification of pasta in the
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18 128 low-GI diet only, comparator diet, macronutrient profile, funding source, and outcome data. The
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20 129 primary outcome was body weight, and secondary outcomes included markers of global (BMI,
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22 130 body fat) and abdominal (waist circumference, waist-to-hip ratio, sagittal abdominal diameter, or
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24 131 visceral adipose tissue assessed by imaging modalities) adiposity. Mean±SD differences between
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26 132 test and control arms were extracted for each outcome.
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31 133 In those trials where the data were included in figures and not provided numerically, we used the
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33 134 software program Plot Digitizer (<http://plotdigitizer.sourceforge.net/>) to extract the data.
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35 135 Additional information was requested from the authors of all included trials. Disagreement were
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37 136 resolved by consensus or where necessary by a third author (SBM).
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42 138 **Risk of bias assessment**

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44 139 Risk of bias for each individual study was assessed using the Cochrane Risk of Bias tool¹⁹. The
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46 140 level of bias was evaluated for sequence generation, allocation concealment, blinding,
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48 141 incomplete outcome data, and selective reporting and determined overall as either low (proper
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50 142 methods taken to reduce bias), high (improper methods creating bias), or unclear (insufficient
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52 143 information provided to determine the bias level).
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5 **145 Statistical analysis**

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8 146 Baseline, end-of-study, and between-treatment differences in body weight, BMI, waist
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10 147 circumference, body fat, waist-to-hip ratio, sagittal abdominal diameter or visceral adipose tissue
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12 148 assessed by imaging modalities were recorded as means±SDs. If not provided, between-
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14 149 treatment differences in change-from-baseline or end differences were calculated by subtracting
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16 150 means and variance measures such as SEs were imputed with the use of published formulas¹⁹.
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19 151 Missing SDs were imputed with the use of the pooled SD from other studies included in the
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21 152 analysis¹⁹.

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24 153 Data analyses were conducted using Review Manager version 5.3 (RevMan) (Copenhagen,
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26 154 Denmark: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) for primary
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28 155 analyses and Stata version 13 (College Station, TX: StataCorp LP) for subgroup analyses. A
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30 156 generic inverse-variance method with random-effects models was used to calculate pooled mean
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32 157 differences and 95% confidence intervals (CIs). Random-effects models were used even in the
33
34 158 absence of statistically significant inter-study heterogeneity, as they yield more conservative
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36 159 summary effect estimates in the presence of residual heterogeneity. Change-from-baseline
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38 160 differences were preferred over end differences and paired analyses were applied to all crossover
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40 161 trials with the use of a within-individual correlation coefficient between treatments of 0.5 as
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42 162 described by Elbourne et al.²¹

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47 163 Inter-study heterogeneity was assessed by the Cochran Q statistic, where $P < 0.10$ was considered
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49 164 statistically significant, and quantified by the I^2 statistic, where $I^2 \geq 50\%$ indicates substantial
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51 165 heterogeneity¹⁹. Sensitivity analysis were performed which included the removal of each single
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53 166 study from the meta-analyses one at a time and recalculation of the summary effect. An

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3 167 influential study was considered a study whose removal changed the magnitude of the pooled
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5 168 effect by >10%. Sensitivity analysis were also conducted using different correlation coefficient
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8 169 values for crossover trials (0.25 and 0.75) to test for the robustness of the effect size, conducting
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10 170 analyses using fixed effects models and restricting analyses to those trials for which pasta intake
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12 171 could be quantified.

14 172 If ≥ 10 trial comparisons were available, then sources of heterogeneity were explored by
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16 173 subgroup analyses. A priori categorical subgroups analyses were assessed by meta-regression
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18 174 analyses. These included patient type (normal body weight, overweight or obese [average
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20 175 baseline BMI $>27\text{kg/m}^2$]), diabetes, coronary heart disease), follow-up (<24 -weeks, ≥ 24 weeks),
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22 176 baseline BMI (BMI ≤ 30 , $>30\text{kg/m}^2$), design (parallel, crossover), energy balance (negative on
23
24 177 both arms [weight loss diets], neutral on both arms [weight maintaining diets]) and dose of pasta
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26 178 (based on the median). A priori categorical subgroup analyses also included the following dietary
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28 179 factors: GI (absolute level [≤ 55 , >55 ; glucose scale], within-treatment change, between-treatment
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30 180 change), fat intake (absolute level [$<30\%$, $\geq 30\%$ energy], within-treatment change, between-
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32 181 treatment change), carbohydrate intake (absolute level [$<50\%$, $\geq 50\%$ energy], within-treatment
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34 182 change, between-treatment change), protein intake (absolute level [$<20\%$, $\geq 20\%$ energy], within-
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36 183 treatment change, between-treatment change), dietary fibre intake (absolute level [$<28\text{g/day}$,
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38 184 $\geq 28\text{g/day}$], within-treatment change, between-treatment change), and risk of bias. A priori
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40 185 continuous meta-regression analyses were conducted on the absolute levels and within- and
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42 186 between-treatment changes of these same dietary factors in the intervention arms of pasta in the
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44 187 context of low-GI dietary patterns. Linear and non-linear pasta intake dose-response analyses
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46 188 were assessed by using continuous meta-regression analyses and spline curve modeling
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48 189 (MKSPLINE procedure), respectively. Publication bias was assessed by visual inspection of
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3 190 funnel plots and the Egger²² and Begg²³ tests, when ≥ 10 trial comparisons were available. If
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5 191 publication bias was suspected, then adjustment for funnel plot asymmetry was done by imputing
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7 192 missing study data using the Duval and Tweedie trim and fill method²⁴.
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11 12 194 **Grading the evidence**

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14 195 The grading of recommendations assessment, development, and evaluation (GRADE) approach
15
16 196 was used to assess the certainty of the evidence²⁵. Evidence was graded as high, moderate, low
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18 197 or very low quality. The included RCTs were graded as high quality evidence by default and
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20 198 downgraded based on pre-specified criteria. Criteria to downgrade evidence included risk of bias
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22 199 (weight of studies show risk of bias assessed by the Cochrane Risk of Bias tool), inconsistency
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24 200 (substantial unexplained heterogeneity, $I^2 > 50\%$, $P < 0.10$), indirectness (presence of factors that
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26 201 limited the generalizability of the results), imprecision (the 95% CI for effect estimates were
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28 202 wide or crossed pre-specified minimally important differences [MIDs] for harm), and publication
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30 203 bias (significant evidence of small-study effects).
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36 37 38 205 **Patient involvement**

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41 206 No patients were directly involved in the development of the research question, selection of the
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43 207 outcome measures, design and implementation of the study, or interpretation of the results.
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47 48 209 **RESULTS**

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51 52 53 211 **Search results**

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3 212 **Figure 1** shows the flow of the literature. We identified 4876 reports of which 29 met eligibility
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5 213 criteria. No reports were identified that assessed the effect of pasta alone, while 29 reports
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7 214 (including 32 trial comparisons involving 2448 participants) were identified that assessed the
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9 215 effect of pasta in the context of low-GI dietary patterns on any adiposity outcome in adults²⁶⁻⁵⁴.
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11 216 Of the 32 trial comparisons that assessed the effect of pasta in the context of a low-GI dietary
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13 217 pattern, there were 32 trial comparisons for body weight, 18 trial comparisons for BMI<sup>27,28,31-
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15 218 33,35,36,39-41,43-46,48,49,52,53</sup>, 18 trial comparisons for waist circumference^{27,28,31,33,34,36,38-40,42,44-47,52,53},
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17 219 10 trial comparisons for body fat^{27,28,31-33,36,38,41,43,53}, 6 trial comparisons for waist-to-hip
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19 220 ratio^{31,39,40,44,45,52}, and 3 trial comparisons for sagittal abdominal diameter^{34,39}. There was only
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21 221 one trial comparison identified³⁵ for visceral adipose tissue assessed by imaging modalities, thus
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23 222 a meta-analysis could not be undertaken for this outcome.
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31 224 **Trial characteristics**

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33 225 **Table 1** and **Supplemental Table S4** show the characteristics of all included trials of the effect
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35 226 of pasta in the context of low-GI dietary patterns. The majority of trials had a parallel design
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37 227 (26/32) with a median follow-up of 12 weeks (IQR: 9–21 weeks) and a median number of
38
39 228 participants per trial of 43 (IQR: 21–112). Most participants were middle aged (median age: 50
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41 229 y; IQR: 40-58 y) men and women (median ratio of men to women: 0.4:1 in available trials). The
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43 230 median baseline BMI across studies was 30.4kg/m² (IQR: 28.2–32.0). Regarding metabolic
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45 231 phenotype, 21 (66%) trials included participants who were overweight or obese (had a baseline
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47 232 BMI \geq 27kg/m²), 10 (31%) had diabetes and one trial (3%) with coronary heart disease (CHD).
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50 233 We did not retrieve any trials where participants had a normal BMI at baseline (\leq 25kg/m²),
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3 234 although 6 trials did not include BMI >25 kg/m² as part of criteria, the average baseline BMI was
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5 235 ≥27 kg/m², therefore categorized as overweight.
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10 237 **Risk of bias**

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12 238 **Supplemental Figures S1 and S2** show the individual Cochrane Risk of Bias tool assessments
13
14 239 for each of the included trials of the effect of pasta in the context of low-GI dietary patterns. No
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16 240 serious risk of bias was detected.
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21 242 **Effect of Pasta in the Context of Low-GI dietary patterns and Body Weight**

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23 243 **Figure 2** shows the effect of pasta in the context of low-GI dietary patterns on the primary
24
25 244 outcome body weight. Pooled analyses showed pasta in the context of low-GI dietary patterns
26
27 245 had the effect of reducing body weight by -0.63 kg (95% CI:-0.84, -0.42 kg; P<0.001) compared
28
29 246 with higher GI control diets with no evidence of heterogeneity (I²=0%, P-heterogeneity=0.51).
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34 248 **Effect of Pasta in the Context of Low-GI dietary patterns on Markers of Global Adiposity**

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36 249 **Figure 3 and Supplemental Figure S3-S4** show the effect of pasta in the context of low-GI
37
38 250 dietary patterns on markers of global adiposity. Pooled analyses showed that pasta in the context
39
40 251 of low-GI dietary patterns had the effect of reducing BMI by -0.26kg/m² (n=18 trials; MD=-
41
42 252 0.26kg/m²; 95% CI:-0.36, -0.16 kg/m²; P<0.001) compared with higher GI control diets with no
43
44 253 evidence of heterogeneity (I²=0%, P-heterogeneity=0.90). There was no effect on body fat (n=10
45
46 254 trials; MD=-0.01%, 95% CI:-0.58, 0.56%; P=0.98) with evidence of substantial heterogeneity
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48 255 (I²=65%, P-heterogeneity<0.01).
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3 **257 Effect of Pasta in the Context of Low-GI dietary patterns on Markers of Abdominal**
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5 **258 Adiposity**

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7 **259 Figure 3 and Supplemental Figures S5-S7** show the pooled estimates for the markers of
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9 abdominal adiposity. Pooled analyses did not show a significant effect of pasta in the context of
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11 abdominal adiposity. Pooled analyses did not show a significant effect of pasta in the context of
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13 low-GI dietary patterns compared with higher-GI control diets on waist circumference (n=18
14
15 trials; MD=-0.46cm, 95% CI:-1.05, 0.14cm; P=0.13), waist-to-hip ratio (n=6 trials; MD=-0.00,
16
17 95% CI:-0.01, 0.00; P=0.27), or sagittal abdominal diameter (n=3 trials, MD=-0.09cm, 95% CI:-
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19 0.34, 0.16cm; P=0.48) There was only evidence of substantial heterogeneity in the analyses for
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21 waist circumference ($I^2=62%$, P-heterogeneity<0.01).
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26 **267 Sensitivity analyses**

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28 We conducted four sets of sensitivity analyses (**Supplemental Tables S5-6, Supplemental**
29
30 **Figures S8-9**). The systematic removal of each trial did not modify the direction or significance
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32 of the effect estimates or the evidence of heterogeneity for any of the outcomes with the
33
34 exception of waist circumference (**Supplemental Table S5**). In the sensitivity analysis for waist
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36 circumference, two studies were influential studies in that their removal altered the magnitude of
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38 the pooled effect in the remaining studies by >10%, where the removal of the studies of
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40 McMillan-Price et al. (high protein comparison)⁴² and Jenkins et al.⁴⁴ rendered the results for
41
42 waist circumference statistically significant (MD= -0.62cm; 95% CI: -1.19, -0.05; P=0.03) and
43
44 (MD= -0.61cm; 95% CI: -1.18, -0.04; P=0.04), respectively; forest plots not shown).
45
46 Heterogeneity remained significant in both cases ($I^2= 55%$, P-heterogeneity<0.01 and $I^2=50%$, P-
47
48 heterogeneity=0.01, respectively). Sensitivity analyses using correlation coefficients of 0.25 and
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50 0.75 for paired analyses of crossover trials also did not modify the results (**Supplemental Table**
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3 280 **S6)**. In the sensitivity analyses where fixed effects models were applied (**Supplemental Figure**
4
5 281 **S8)**, the direction, magnitude and significance of the pooled estimates were very similar to those
6
7 282 produced by the random effects models with the exception of the sensitivity analysis for waist
8
9 283 circumference which was significant (MD= -0.62; 95% CI: -0.93, -0.32; P<0.001). Finally,
10
11 284 restricting analyses to the 11 trials for which pasta intake could be quantified (median pasta
12
13 285 intake, 3.33 servings/week [range, 1.75 – 7 servings/week]) showed a similar reduction in body
14
15 286 weight (MD= -0.70 kg; 95% CI:-1.10, -0.29 kg; P<0.001) when pasta was consumed in the
16
17 287 context of low-GI dietary patterns compared with the higher GI control arms without evidence of
18
19 288 heterogeneity ($I^2=0\%$, P-heterogeneity=0.68) (**Supplemental Figure S9**).

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25 290 **Subgroup analyses**

26
27 291 We were only able to conduct a priori categorical and continuous subgroup analyses for body
28
29 292 weight, BMI, body fat and waist circumference. Subgroup analyses for waist-to-hip ratio and
30
31 293 sagittal abdominal diameter could not be assessed, owing to <10 trial comparisons in each case.

32
33 294 **Supplemental Figures S10-S12** show the categorical a priori subgroup analyses for body
34
35 295 weight. There was no evidence of significant effect modification in any of the subgroup analyses
36
37 296 for body weight, including no effect modification of follow-up when comparing studies less than
38
39 297 24 weeks duration to those greater than or equal to 24 weeks (-0.63kg vs -0.57kg, respectively)
40
41 298 (**Supplemental Figure S10**). Neither was there evidence of significant effect modification in any
42
43 299 of the subgroup analyses for BMI, body fat or waist circumference (**Supplemental Figures S13-**
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45 300 **20**).

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3 302 **Supplemental Table S7** and **Supplemental Figures S21-22** show the continuous subgroup
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5 303 analyses for body weight. There was evidence of significant effect modification by carbohydrate
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7 304 and protein intake, where an increase in carbohydrate intake in the intervention group in which
8
9 305 pasta was consumed in the context of low-GI dietary patterns was associated with weight loss
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11 306 ($\beta = -0.07$, 95% CI: -0.12, -0.01, $I^2 = 0.00\%$, $P = 0.02$), and an increase in protein intake in the
12
13 307 intervention group in which pasta was consumed in the context of low-GI dietary patterns was
14
15 308 associated with weight gain ($\beta = 0.15$, 95% CI: 0.03, 0.27, $I^2 = 0.00\%$, $P = 0.02$). None of the other
16
17 309 continuous subgroup analyses were significant. There was no evidence of significant effect
18
19 310 modification in any of the continuous subgroup analyses for BMI (**Supplemental Table S8**). For
20
21 311 body fat, there was evidence of significant effect modification in the continuous meta-regression
22
23 312 subgroup analysis of difference in GI between intervention and control groups, where greater
24
25 313 difference in GI between the groups was associated with greater reduction in body fat in the
26
27 314 intervention group ($\beta = -0.09$, 95% CI: -0.15, -0.03, $I^2 = 19.39\%$, $P = 0.01$) (**Supplemental Table**
28
29 315 **S9**). None of the other continuous subgroup analyses were significant. For waist circumference,
30
31 316 there was evidence of significant effect modification in the continuous meta-regression subgroup
32
33 317 analysis of absolute carbohydrate level and absolute protein level, where greater carbohydrate
34
35 318 level in the intervention group in which pasta was consumed in the context of low-GI dietary
36
37 319 patterns was associated with greater loss in waist circumference ($\beta = -0.11$, 95% CI: -0.19, -0.04,
38
39 320 $I^2 = 27.06\%$, $P < 0.01$) and a lower protein level in the intervention group in which pasta was
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41 321 consumed in the context of low-GI dietary patterns was associated with an increase in waist
42
43 322 circumference ($\beta = 0.20$, 95% CI: 0.01, 0.38, $I^2 = 43.92\%$, $P = 0.04$) (**Supplemental Table S10**).
44
45 323 None of the other continuous subgroup analyses were significant.
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325 **Dose-response analyses**

326 **Supplemental Tables S7 and S11** and **Supplemental Figure S23** show the dose-response
327 analysis for the 11 trials for which pasta intake could be quantified. No evidence of a linear dose
328 response was seen for pasta intake by meta-regression analyses (**Supplemental Table S7**).
329 There was also no evidence of a non-linear dose response by MKSPLINE (P=0.85)
330 (**Supplemental Figure S23**) or piecewise linear meta-regression analyses (**Supplemental Table**
331 **S7**).

333 **Publication Bias**

334 **Supplemental Figures S24-S27** shows the funnel plots for body weight, BMI, body fat and
335 waist circumference. There was no evidence of funnel-plot asymmetry. Formal testing with the
336 Egger and Begg tests did not show evidence of small-study effects (P>0.05 for both). Publication
337 bias was not assessed for waist-to-hip ratio and sagittal abdominal diameter, owing to <10 trial
338 comparisons.

340 **GRADE Assessment**

341 **Supplemental Table S12** shows a summary of the GRADE assessments for the effect of pasta in
342 the context of low-GI dietary patterns on body weight and measures of adiposity. The evidence
343 was graded as moderate for body weight, BMI, waist-to-hip ratio and sagittal abdominal
344 diameter owing to downgrades for indirectness and low for waist circumference and body fat,
345 owing to downgrades for indirectness and inconsistency ($I^2=59%$, P-heterogeneity<0.001;
346 $I^2=66%$, P-heterogeneity<0.01, respectively).

347

DISCUSSION

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349 The present systematic review and meta-analysis quantified the effect of pasta alone and pasta in
350 the context of low-GI dietary patterns on body weight and other markers of adiposity. We
351 identified no trial comparisons for the effect of pasta alone and 32 trial comparisons involving
352 2448 participants who were predominantly middle-aged and overweight or obese for the effect of
353 pasta in the context of low-GI dietary patterns. The primary pooled analysis demonstrated that
354 pasta in the context of low-GI dietary patterns did not contribute to weight gain, resulting in a
355 significant weight loss of -0.63kg when compared to diets higher in GI over a median follow-up
356 of 12 weeks. The lack of harm was reflected in the established clinical secondary outcome
357 measures of global (BMI and body fat) and abdominal adiposity (waist circumference, waist-to-
358 hip ratio and sagittal abdominal diameter). These findings were robust across subgroups. The
359 findings did not differ by metabolic phenotype in those who were overweight or obese or had
360 diabetes, which is noteworthy since these are populations who would benefit from weight
361 management strategies. There was also no effect modification by the energy balance of the
362 design such that the weight loss was seen even under conditions of neutral energy balance (in
363 which participants were instructed to consume dietary advice ad libitum), suggesting that
364 encouragement of the consumption of pasta in the context of a low-GI dietary patterns does not
365 cause harm and may even lead to spontaneous weight loss. There was also no effect modification
366 by follow-up either in continuous meta-regression or categorical, where the 24 trials with
367 <24weeks follow-up had a weight reduction similar to those 8 trials with ≥24weeks follow-up (-
368 0.63kg vs -0.57kg, respectively). This is of relevance since many dietary studies are successful in
369 demonstrating weight loss in the short term but not over the long term.

370

371 **Findings in the context of existing studies**

372 We are not aware of any RCTs directly assessing the effect of pasta intake on health parameters
373 including body weight. Our findings, however, agree with earlier systematic reviews and meta-
374 analyses of RCTs of the effect of low-GI dietary patterns irrespective of pasta intake on body
375 weight and adiposity. The systematic review and meta-analysis by Thomas et al. in 2007 found a
376 significant -1.1kg weight loss and -1.3kg/m² reduction in BMI favouring low-GI or glyceic
377 load (GL) diets compared to control diets in 6 RCTs of 5 weeks to 6 months in duration in
378 overweight or obese individuals¹³. Another systematic review and meta-analysis by
379 Schwingshackl et al. in 2013 found a -0.62kg weight loss favouring low-GI/GL diets compared
380 to higher GI/GL diets in 14 RCTs with greater than 6 months duration in overweight individuals
381 (BMI>25kg/m²)¹⁴.

382
383 Our findings also agree with trials in which pasta was emphasized in the context of other healthy
384 dietary patterns. One trial done in children in Spain given Mediterranean dietary advice which
385 included increasing the intake of pasta found that approximately 11.3% of the participants in the
386 Mediterranean diet group who were classified as overweight and obese changed their weight
387 status to normal weight compared to only approximately 2.6% of the participants in the control
388 group⁵⁵.

389
390 Other lines of evidence from observational studies have demonstrated benefits of pasta
391 consumption on body weight and adiposity. Pasta intake was recently assessed in the Moli-sani
392 study and the Italian Nutrition & HEalth Survey (INHES), a cross-sectional study of over
393 20,000 Italians from all over Italy⁵⁶. The study demonstrated that higher pasta consumption was

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3 394 associated with lower BMI, waist circumference and waist-to-hip ratio and with a lower
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5 395 prevalence of overweight and obesity⁵⁶. Furthermore, greater pasta intake was associated with
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7 396 better adherence to the Mediterranean diet, a dietary pattern which has a demonstrated
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10 397 cardiovascular benefit⁵⁷. Similar associations between greater pasta intake and lower body
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12 398 weight have also been observed in prospective U.S. cohorts⁵⁸. A pooled analysis of the 3
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14 399 Harvard cohorts also showed that higher GI diets (which would preclude pasta) were associated
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17 400 with weight gain⁵⁹.

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21 402 Although the product form of pasta can vary widely, including in shape (e.g. macaroni, spaghetti,
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23 403 linguine), ingredients (e.g. type of wheat, egg content), and processing technique (e.g. drying
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25 404 temperature), studies have demonstrated that when comparing pastas varying in these
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28 405 parameters, despite slight variations in glycemic response among pastas, glycemic responses are
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30 406 still lower compared to a control, e.g. white bread^{60,61}. One concern of the choice of pasta as a
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32 407 carbohydrate food is that it is a refined food low in fibre. Although there are whole grain pasta
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34 408 options available, studies have demonstrated that fiber added to pasta, does not significantly
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37 409 affect the glucose or insulin response, the secretion of gut hormones or satiety^{62,63}. Furthermore,
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39 410 pasta has a similar glycemic response compared to many fiber-rich carbohydrates, including
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41 411 barley, legumes and steel cut oats, and still a lower glycemic response compared to other fiber-
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43 412 rich foods including whole wheat bread, breakfast cereals like bran flakes and potatoes with
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45 413 skin⁶⁴. The typically consumed white wheat pasta also has a higher micronutrient content
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48 414 compared to other white wheat products like bread since it contains the aleurone layer which is
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50 415 preserved as a result of the use of harder wheats (durum wheat); even when durum wheats are
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53 416 used in breads, pasta retains a lower glycemic response primarily because of the processing
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3 417 techniques used in pasta making which give pasta a compact structure and reduced starch
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5 418 hydrolysis⁶¹.

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10 420 The mechanism by which pasta in the context of low-GI dietary patterns lead to weight loss even
11
12 421 under conditions of ad libitum dietary advice is unclear. Lower GI diets may result in greater
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14 422 body weight reduction compared to higher GI diets because lower GI foods may be more
15
16 423 satiating⁶⁵ and have been shown to delay hunger and decrease subsequent energy intake¹³. Low-
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18 424 GI dietary patterns are also characterized by high fiber content^{64,66} which may also contribute to
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20 425 improvements in satiety and hunger¹⁷. Furthermore, studies which have compared ad libitum
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22 426 low-GI dietary patterns to standard energy-restricted low-fat diets, demonstrated equivalency or
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24 427 better weight loss when following the low-GI diet, despite the fact that they could eat as much as
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26 428 they desired^{13,67}. Thus, voluntary energy intake may be lower after low-GI meals, as has been
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28 429 previously demonstrated⁶⁸.

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34 35 431 **Strengths and limitations**

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37 432 The strengths of the present systematic review and meta-analysis include that it is
38
39 433 comprehensive, includes RCTs which protects against bias and uses GRADE to evaluate the
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41 434 quality of evidence. Additionally, a large number of trials were identified (32 trials) for the
42
43 435 primary outcome of body weight, the median follow-up period was 12 weeks which allows for
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45 436 the assessment of a moderate duration of intervention, none of the trials were rated as having a
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47 437 serious risk of bias, and there was no evidence of publication bias.

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3 439 There are several limitations. First, we downgraded the certainty of the evidence for serious
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5 440 inconsistency in the treatment estimates across trials for some of the outcomes assessed. There
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7 441 was evidence of unexplained heterogeneity in waist circumference ($I^2=62\%$) and in body fat
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9 442 ($I^2=65\%$). Although the inconsistency in these outcomes may have related to measurement
10
11 443 error⁶⁹ in the different techniques for measuring waist circumference and body fat, we were
12
13 444 unable to conduct sensitivity or subgroup analyses to explore this source of heterogeneity.
14
15 445 Second, we downgraded the certainty of the evidence for serious indirectness. Most of the
16
17 446 available trials did not quantify the amount of pasta consumed in the context of the low-GI
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19 447 dietary patterns. Although sensitivity analyses in which analyses were restricted to the 11 trials
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21 448 that did quantify (providing a median 3.33 servings/week) pasta intake did not meaningfully alter
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23 449 our estimates (-0.70kg versus -0.63kg), it is difficult to quantify the effect of pasta in these diets.
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25 450 There is also the question of indirectness in the translation to other background diets. None of the
26
27 451 available trials evaluated the effect of pasta alone or in the context of other dietary patterns.
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29 452 Whether the observed effect of pasta in the context of low-GI dietary patterns will hold in the
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31 453 context of other healthy dietary patterns, such as Mediterranean and Vegetarian dietary patterns,
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33 454 is unclear. Although there is no biological reason to doubt that the findings would hold across
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35 455 different dietary patterns, there was no direct evidence to support this conclusion. If the question
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37 456 had been asked from the perspective of benefit as opposed to that of harm, then the relatively
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39 457 short duration of the included trials is another reason to downgrade for serious indirectness. In
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41 458 the absence of long-term trials (>1 year diet duration), it is difficult to conclude with certainty
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43 459 that the observed lack of harm implies an actual sustainable benefit. Finally, there was some
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45 460 evidence of imprecision for benefit. Whereas the 95% CI of the pooled estimates did not overlap
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47 461 with our pre-specified MID for harm (that is, they did not contain evidence for harm) and so
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3 462 were not downgraded for imprecision, the upper bound of the 95% CI did overlap with the lower
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5 463 bound of the same MID to assess the precision of the evidence for benefit for some outcomes.
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10 465 Balancing these strengths and limitations, GRADE assessed the overall quality and strength of
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12 466 the available evidence of the effect of pasta in the context of low-GI dietary patterns as moderate
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14 467 for the primary outcome of body weight and the secondary outcomes of BMI, waist-to-hip ratio
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16 468 and sagittal abdominal diameter owing to downgrades for indirectness. The evidence was
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19 469 assessed as low for the other secondary outcomes of body fat and waist circumference owing to
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21 470 downgrades for indirectness and inconsistency.
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25 26 472 **Implications**

27
28 473 These results are important considering the negative messages directed at the public regarding
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30 474 carbohydrates, which is influencing their food choices, as is evident in recent reductions in
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32 475 carbohydrate intake⁷⁰⁻⁷², and in particular reductions in pasta consumption^{70,73-76}. Contrary to
33
34 476 these concerns, the available evidence shows that when pasta is consumed in the context of low-
35
36 477 GI dietary patterns that there is not weight gain but rather marginally clinically significant weight
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38 478 loss (>0.5kg)⁷⁷.
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44 480 Although we were able to approximate the amount of pasta consumed in one third of included
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46 481 trials, it is unclear what the effect of pasta would be in the context of other dietary patterns. Low-
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48 482 GI dietary patterns, however, shares many similarities with a Mediterranean diet, which
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50 483 emphasizes many low-GI foods and has demonstrated a CVD benefit⁵⁷.
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3 485 Current clinical practice guidelines already suggest the replacement of high GI foods with low-
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5 486 GI foods for improvement of glycemic control and cardiovascular risk factors^{78,79}. The present
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7 487 evidence means that pasta may be highlighted as an important example of a low-GI food which
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9 488 can contribute to a low-GI dietary pattern, a pattern which in turn may potentially improve
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11 489 cardio-metabolic risk without an adverse effect on weight control.
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17 491 CONCLUSIONS

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19 492 In conclusion, the available evidence from RCTs does not allow us to conclude that pasta
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21 493 consumed in the context of low-GI dietary patterns has an adverse effect on body weight and
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23 494 adiposity outcomes of importance in the prevention and management of overweight and obesity.
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25 495 On the contrary, pasta in the context of low-GI dietary patterns reduces body weight and BMI
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27 496 compared with higher-GI dietary patterns. The results are generalizable in the context of a high
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29 497 carbohydrate dietary pattern composed of low-GI foods with or without the intention of weight
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31 498 loss in middle-aged individuals who are overweight or obese or have diabetes. Although the
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33 499 clinical significance of the observed weight loss is debatable, this finding increases our
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35 500 confidence that pasta in the context of low-GI dietary patterns does not result in weight gain.
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37 501 Further research may change our confidence in the estimates for our primary outcome body
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39 502 weight and several key secondary outcomes including BMI and two measures of abdominal
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41 503 adiposity, waist-to-hip ratio and sagittal abdominal diameter. More research is needed, to
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43 504 improve our estimates for the secondary outcomes, body fat and waist circumference and assess
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45 505 whether our findings extend to related cardio-metabolic outcomes. There is also a need for more
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47 506 randomized trials of >1 year diet duration to clarify whether the lack of harm for pasta in the
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49 507 context of low-GI dietary patterns will translate into meaningful long-term benefits. Other
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3 508 randomized trials should focus on whether pasta will have similar effects in the context of other
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5 509 healthy dietary patterns such as a Mediterranean diet.
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For peer review only

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3 512 **Figure Legend**
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5 513 **Figure 1:** Literature Search
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7 514 **Figure 2:** Forest plot of randomized controlled trials investigating the effects of pasta in the
8 context of low-GI dietary patterns on body weight (kg). n = 2448. Data are expressed as mean
9 differences represented by a square and 95% CIs by the line through the square. 95% CIs
10 516 exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are
11 517 represented by diamonds and were estimated with the use of generic inverse variance random
12 518 effects models. Between-study heterogeneity was detected with the use of the Cochran's Q
13 519 statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where
14 520 $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable
15 521 heterogeneity.
16 522

17 523 CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic
18 524 index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty
19 525 acids; Pro, protein.
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23 527 **Figure 3:** Plot of pooled effect estimates from randomized controlled trials investigating the
24 528 effects of pasta in the context of low-GI dietary patterns on global and abdominal markers of
25 529 adiposity. Pooled effect estimates are represented by diamonds and were estimated with the use
26 530 of generic inverse variance random effects models. Between-study heterogeneity was detected
27 531 with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the
28 532 use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and
29 533 $\geq 75\%$ considerable heterogeneity.

30 534 BMI; body mass index; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic
31 535 index; LGI, low glycemic index diet.
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20 **545 Data Sharing**
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23 546 No additional data available.
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28 **548 Exclusive License**
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29 663 Alabama at Birmingham, Oldways Preservation Trust, Nutrition Foundation of Italy (NFI),
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31 664 Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of
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33 665 Diabetes (EASD), International Life Sciences Institute (ILSI) North America, Dr. Pepper
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35 666 Snapple Group, Corn Refiners Association, World Sugar Research Organization, Dairy Farmers
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37 667 of Canada, Società Italiana di Nutrizione Umana (SINU), III World Congress of Public Health
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39 668 Nutrition, C3 Collaborating for Health, Sprim Brasil, WhiteWave Foods, Rippe Lifestyle,
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41 669 mdBriefcase, Federation of European Nutrition Societies (FENS), New York Academy of
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43 670 Sciences, International Diabetes Federation, American Heart Association (AHA), American
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45 671 Society for Nutrition (ASN), FoodMinds LLC, Memac Ogilvy & Mather LLC, Pulse Canada,
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47 672 Pepsico, BCFN Foundation, The Ginger Network LLC, and Dietitians of Canada. He has ad hoc
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3 673 consulting arrangements with Winston & Strawn LLP, Perkins Coie LLP, and Tate & Lyle. He is
4
5 674 a member of the European Fruit Juice Association Scientific Expert Panel. He is on Clinical
6
7 675 Practice Guidelines Expert Committees of the Canadian Diabetes Association (CDA) European
8
9 676 Association for the study of Diabetes (EASD), and Canadian Cardiovascular Society (CCS), as
10
11 677 well as an expert writing panel of the American Society for Nutrition (ASN). He serves as an
12
13 678 unpaid scientific advisor for the Food, Nutrition, and Safety Program (FNSP) and the Technical
14
15 679 Committee on Carbohydrates of the International Life Science Institute (ILSI) North America.
16
17 680 He is a member of the International Carbohydrate Quality Consortium (ICQC), Executive Board
18
19 681 Member of the Diabetes and Nutrition Study Group (DNSG) of the EASD, and Director of the
20
21 682 Toronto 3D Knowledge Synthesis and Clinical Trials foundation. His wife is an employee of
22
23 683 Unilever Canada. No competing interests were declared by **CR Braunstein, S Blanco Mejia,**
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28 684 **and LA Leiter.**
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884 **Table 1:** Summary of trial characteristics

Trial Characteristics*	ALL	Neutral Energy Balance	Negative Energy Balance
Trial Number (n)	32	23	9
Trial Size (total, range)	2448 (8 - 250)	1989 (8 - 250)	459 (13 - 123)
Male: Female^a (%)	40:60	47:53	27:73
Age (years)	50 (40 - 58)	52.0 (42.1 – 59.5)	49.5 (34.2 – 53.0)
Metabolic Phenotype (OW/OB:DM:CHD) (%)	66:31:3	57:39:4	89:11:0
Setting (IP:OP) (%)	3:97	4:96	0:100
Baseline Body Weight (kg)^b	85.5 (80.0 - 91.9)	84.1 (79.5 – 87.5)	92.5 (86.1 – 93.9)
Baseline BMI (kg/m²)^c	30.4 (28.2 - 32.0)	29.5 (27.4 – 31.4)	31.7 (30.1 – 32.9)
Study Design (C:P) (%)	19:81	26:74	0:100
Dose Pasta (servings/week)^d	3.3 (2.3 - 3.5)	3.4 (2.9 – 4.1)	2.3 (2.3-3.5)
GI in Pasta/LGI group	49.0 (44.0 - 55.1)	46.5 (49.9 – 55.5)	44.0 (42.3 - 49.4)
GI in Higher GI group	62.5 (61.6 - 63.2)	63.3 (60.1 – 64.4)	61.0 (59.2 – 66.6)
Calorie reduction in Pasta/LGI group (kcal)^e	-179 (-90 - -448)	-165 (-74 - -313)	-447 (-134 - -594)
Calorie reduction in Higher GI group (kcal)^e	-181 (-93 - -401)	-160 (-40 - -248)	-470 (-172 - -561)
Feeding Control (Met:Supp:DA) (%)	6:44:50	4:48:48	11:33:56
Follow-Up Duration (Weeks)	12 (9-21)	12 (6-24)	12 (10 - 21)
Funding Sources (A:I:AI:NR) (%)	47:9:25:19	44:13:26:17	56:0:22:22

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886 * median (inter quartile range), unless otherwise indicated
887 ^a24/32 trials provided data on sex
888 ^b 30/32 trials reported baseline body weight
889 ^c 28/32 trials reported baseline BMI
890 ^d 11/32 trials provided data from which dose could be approximated
891 ^e 20/32 trials provided data from which to approximate changes in caloric intake
892 A, agency; AI, agency and industry; BMI, body mass index; C, crossover design; CHD, coronary
893 heart disease; DA, dietary advice; DM, diabetes; GI, glycemic index; I, industry; IP, inpatient;
894 LGI, low glycemic index; Met, metabolic; NR, not reported; OB, obese; OP, outpatient; OW,
895 overweight; P, parallel design; Suppl, supplemented/provision of certain food

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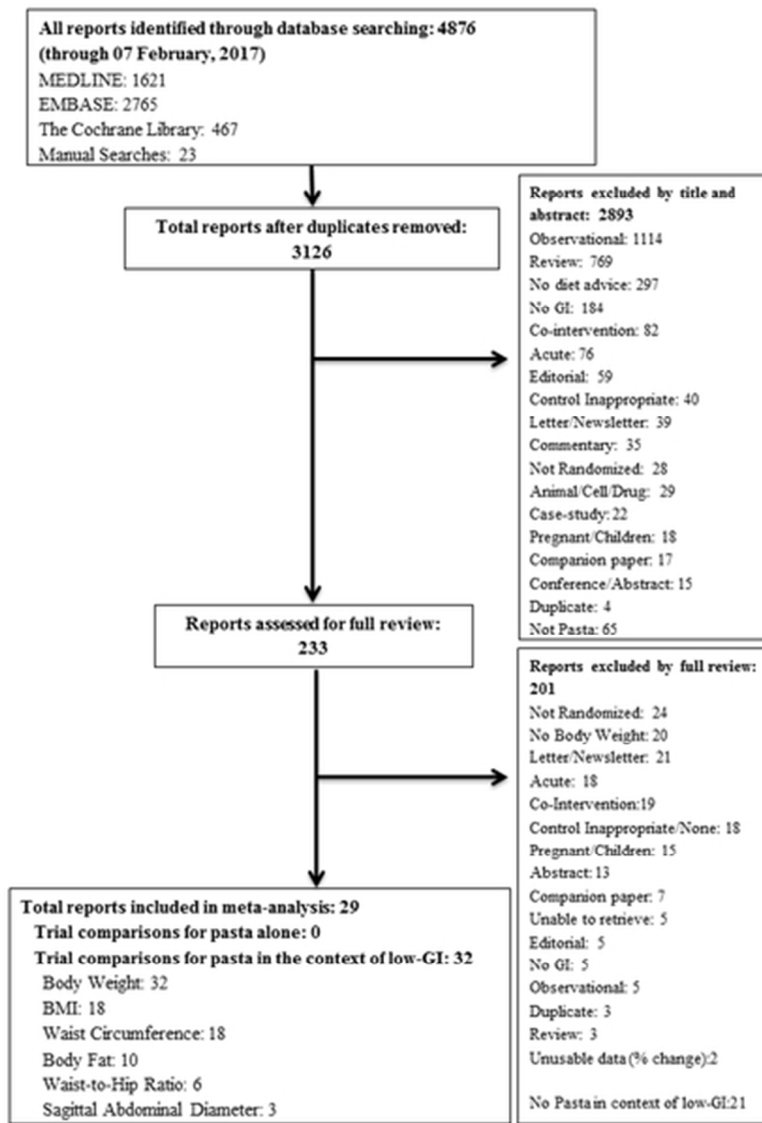


Figure 1: Literature Search

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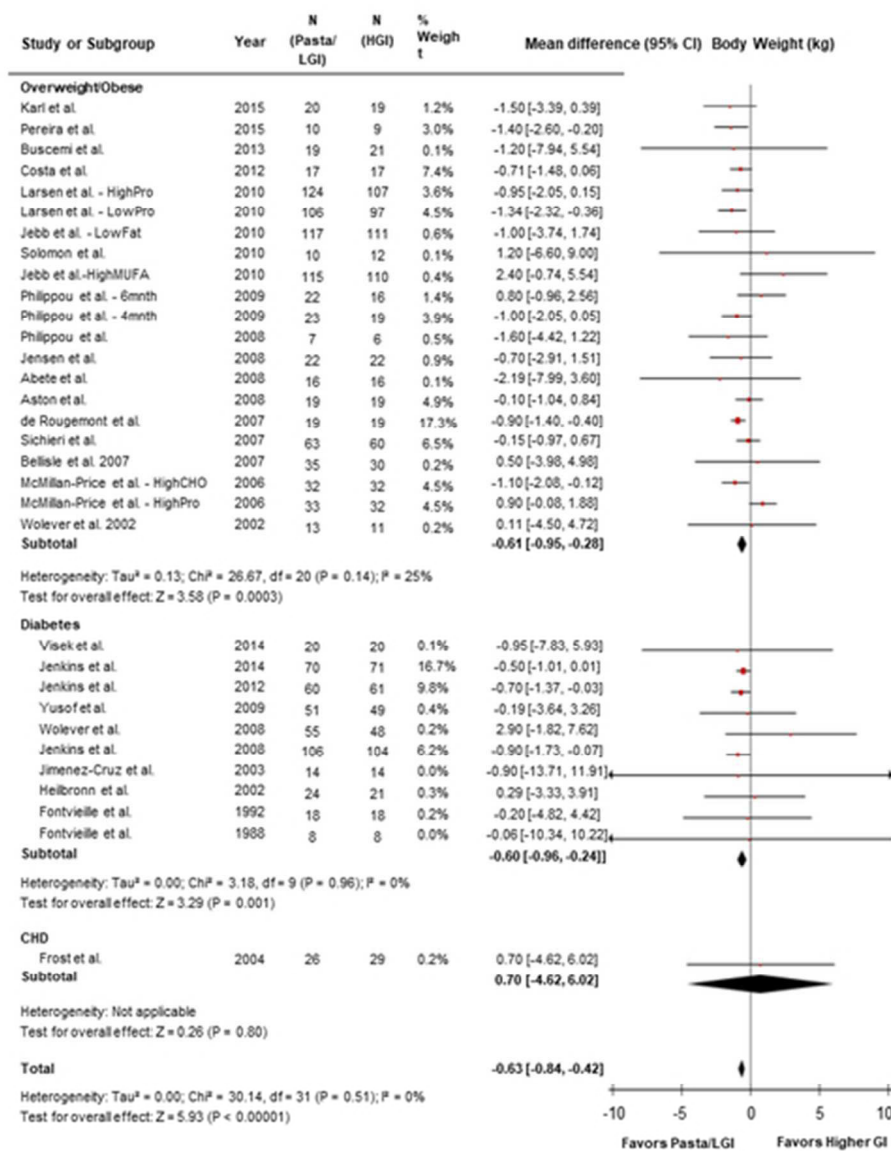


Figure 2: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg). n = 2448. Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids; Pro, protein.

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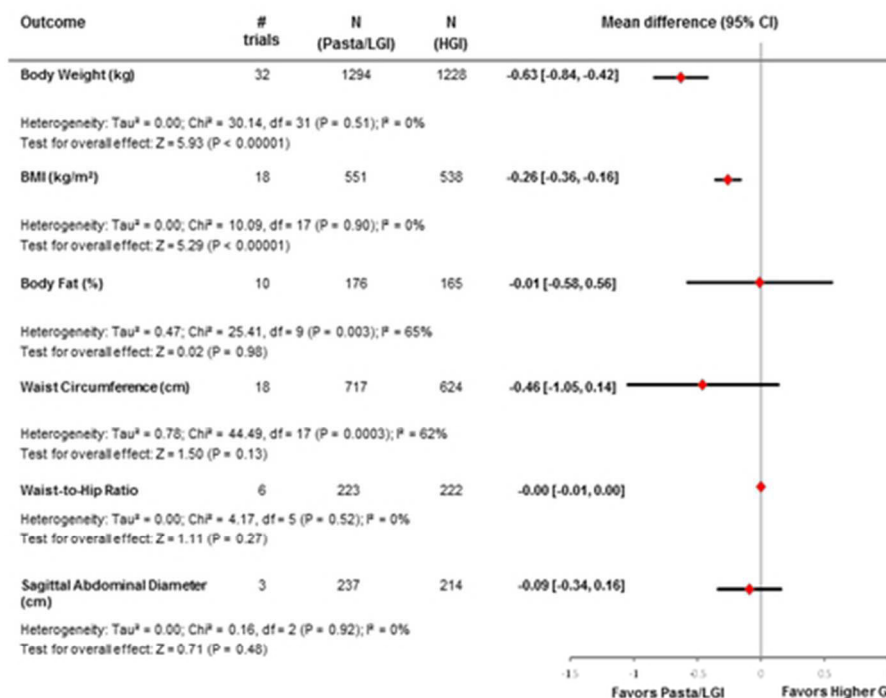


Figure 3: Plot of pooled effect estimates from randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on global and abdominal markers of adiposity. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran’s Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

BMI; body mass index; CI, confidence interval; HGI, higher glycemic index diet; LGI, low glycemic index diet.

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Online Supplemental Information

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Supplemental Tables

Supplemental Table S1: PRISMA Checklist



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	6
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6-7, Supplemental Table S2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6, Supplemental Table S1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplemental Table S1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6-7, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7, Supplemental Table S2
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8-10

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	10
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	8-10
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	11, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	11-12, Table 1, Supplemental Tables S2-S3
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	12, Supplemental Figures S1-S2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	12-13, Figures 2-3, Supplemental Figures S3-S7
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	12-13, Figures 2-3, Supplemental Figures S3-S7
Risk of bias	22	Present results of any assessment of risk of bias across studies	12,16

across studies		(see Item 15).	Supplemental Table S1, S2, S12, S15, S17, S20
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	13-16, Supplemental Tables S4-S10, Supplemental Figures S8-S26
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	17-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20-22
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	22-24
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	27-28

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Supplemental Table S2: Search strategy for studies assessing the effect of pasta in the context of low-GI dietary patterns on body weight in randomized controlled trials

Database	Search Period	Search Terms
Medline	1946 to February 07, 2017	<ol style="list-style-type: none"> 1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycaemic index.tw. 8. glycemic index.tw. 9. glycaemic ind*.tw. 10. glycemic ind*.tw. 11. glycemic load*.tw. 12. glycaemic load*.tw. 13. glycemic index/ 14. body mass index/ 15. body mass index.tw. 16. BMI.tw. 17. overweight.tw. 18. weight*.tw. 19. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 20. 14 or 15 or 16 or 17 or 18 21. 19 and 20 22. limit 21 to animals 23. 21 not 22
Embase	1946 to February 07, 2017	<ol style="list-style-type: none"> 1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycaemic index.tw. 8. glycemic index.tw. 9. glycaemic ind*.tw. 10. glycemic ind*.tw. 11. glycemic load*.tw. 12. glycaemic load*.tw. 13. glycemic index/ 14. body mass index/ 15. body mass index.tw. 16. BMI.tw. 17. overweight.tw. 18. weight*.tw.

		<p>19. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 20. 14 or 15 or 16 or 17 or 18 21. 19 and 20 22. limit 21 to animals 23. 21 not 22</p>
The Cochrane Library	1946 to February 07, 2017	<p>1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycemic index/ 8. glycaemic ind*.tw. 9. glycemic ind*.tw. 10. glycemic load*.tw. 11. glycaemic load*.tw. 12. exp body weight/ 13. body weight*.tw. 14. BMI.tw. 15. body mass index/ 16. body mass index.tw. 17. weight*.tw. 18. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 19. 12 or 13 or 14 or 15 or 16 or 17 20. 18 and 19 21. limit 20 to animals 22. 20 not 21</p>

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Supplemental Table S3: PICO framework of the search strategy

PICO framework^a defined in the present systematic review and meta-analysis			
Participants	Interventions	Comparators	Outcomes
Adult men and women excluding pregnant or breastfeeding women	Low glycemic index interventions where pasta is included as part of the intervention	Higher glycemic index diets where pasta is not included as part of the intervention	Body weight Body mass index (BMI) Body Fat (%) Waist circumference Waist-to-hip ratio

a Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA and PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Systematic Reviews 2015; 4:1. <https://doi.org/10.1186/2046-4053-4-1>

Supplement Table S4a: Trial characteristics

Overweight/Obese Trials														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Karl et al. 2015 †††	39 (19M:20F)**	OB, OP					2.33	USA	P	Negative+ Neutral	17		CR to 2/3kcal; Metabolic	Agency
Low GI	20		56 (5)*	92.9 (13.6)*	32.3 (3.4)*	42:133						68:15:16		
Higher GI	19		56 (5)*	94 (9.7)*	33.4 (2.6)*	61:201						70:16:14		
Pereira et al. 2015	19 (4M:15F)**	OW, IP/OP					NR	Brazil	P	Neutral	6.4		Ad libitum	Unknown
Low GI	10		28(5)	80.0(12.6)	29.9 (2.1)	41.2(2.2) ¥ **						48.3:16.1:32.8		
Higher GI	9		26(3)	79.1(12.2)	29.1 (2.0)	74.1(2.9) ¥ **						54.6:12.7:34.4		
Buscemi et al. 2013	40 (19M:21F)**	OW/OB, high CVD risk, OP					NR	Italy	P	Negative	12		CR to 20kcal/kg/d; Ad libitum	Unknown
Low GI	19		51 (8)	93.8 (17.3)	34.3 (6.6)	48.1: 138						56:18:26		
Higher GI	21		49 (8)	93.2 (14.4)	34.5 (5.1)	59.3: 174						57:16:27		
Costa et al. 2012	17 (7M:10F)	OW, IP/OP	25.4 (5.8)	84.1(16.3)	26.3(3.2)		NR	Brazil	C	Neutral	4		Ab libitum,2 meals+3 fruit/d provided	NR
Low GI						47.5(3.8)						58.6:13.9:25.5		
Higher GI						61.6(2.8)						55.4:14.2:30.3		
Jebb et al. 2010 - High MUFA	225**	OH, some CV risk factors, OP	~52		~28.5 ⁺		1.75	UK	P	Neutral	24		Ad Libitum, key foods provided	Agency, foods by industry
Low GI	115			83.7 (69.6-93.1)¶¶¶		~55.2						~44.6:16.4:35.7****		
Higher GI	110			80.5 (70.0-92.1)¶¶¶		~63.3						~44.9:15.3:35.6****		
Jebb et al. 2010 - Low Fat	250**	OH, some CV risk factors, OP	~52		~28.5 ⁺		3.5	UK	P	Neutral	24		Ad Libitum, key foods provided	Agency, foods by industry
Low GI	117			79.4 (70.1- 91.8)¶¶¶		~56.3						~51.5:14.2:26.1****		
Higher GI	111			80.7 (71.4- 91.4)¶¶¶		~64.4						~51.1:15.7:27.5****		
Larsen et al. 2010-High Pro	231**	OW/OB, OP			NR		NR	Europe	P	Neutral	26		Ad libitum	Agency
Low GI	124		42.1 (6.5)	88.5 (15.6)		~56.5: 108.9						~43:22:32		
Higher GI	107		42 (5.7)	89.5 (17.1)		~61.4: 113.1						~45:23:31		
Larsen et al. 2010 - Low Pro	203 **	OW/OB, OP			NR		NR	Europe	P	Neutral	26		Ad libitum	Agency
Low GI	106		42.2 (5.7)	88.4 (15.7)		~56.2: 121						~51:18:30		
Higher GI	97		42 (5.9)	86.6 (13.8)		~61.6: 137.9						~51:17:31		

Supplement Table S4b: Trial characteristics continued

Overweight/Obese Trials continued															
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source	
Solomon et al. 2010	22 (8M:14F)**	OB, Pre-T2DM, OP					7	USA	P	Neutral	12		Metabolic plus exercise program	Agency	
Low GI	10 (3M:7F)		67 (6)	97.4 (12.0)	34.9 (1.1)	39.8 (0.9)						54.7(0.3):28.3(0.3):17.0(0.3)			
Higher GI	12 (5M:7F)		64 (3)	94.7 (15.2)	34.1 (1.1)	80.0 (2.1)						55.6(0.7):27.8(0.7):16.6(0.3)			
Philippou et al. 2009- 6 mo	38**	≥1 CHD risk factors, OP	(35-65) ¶				NR	UK	P	Negative (for all but n=2)	24		500kcal CR; Ad libitum	Agency	
Low GI	22			91.3(14.8)***	29.1 (3.6)***	50.6 (4.6): 114.4(31.5)									
Higher GI	16			97.5(16.4)***	30.5 (3.5)***	63.2(5.6): 175.0(45.6)									
Philippou et al. 2009- 4 mo	42**	OW, OP	(18-65)¶				NR	UK	P	Neutral	16		Ad libitum	Unknown	
Low GI	23			87.2 (15.3)	32.5 (4.8)	49.7(5.7):89.7(27.5)						47.6(6.7):19.5(4.2):31.8(5.8)			
Higher GI	19			83.6 (13.4)	31.3 (4.8)	63.7(9.4):136.8(56.3)						48.9(7):19.3(4.9):30.9(9)			
Abete et al. 2008	32 (18M:14F)	OB, OP	36(7)				2.33	Spain	P	Negative	8		30% CR; Ad libitum, 3-day menus	Agency	
Low GI	16			94.3(16.1)	32.8 (4.3)	(40-45)¶						50.2 (1.8):18.3(1.6):31.5(1.6)			
Higher GI	16			94.4(13.1)	32.2 (4.4)	(60-65)¶						47.8(6.8):19.6(5.6):32.6(4.3)			
Aston et al. 2008	19 (0M:19F)**	OW/OB, OP	51.9(7.6)	87.5 (15)	33.1 (4.9)		3.33	UK	C	Neutral	12		Ad libitum, key CHO foods provided	Agency	
Low GI						55.5(3.8): 133.8(22.9)*****						51.4(6.0):17.0(2.4):32.2(5.1)* ***			
Higher GI						63.9(3): 138.8(30.5)*****						47.6(6.1):17.6(3.3):34.1(5.7)* ***			
Jensen et al. 2008	44 (0M:44F)**	OW, OP	(20-40)¶				3	Denmark	P	Neutral	10		Ad libitum, partial provision, menu plans	Agency, Industry	
Low GI	22 (0M:22F)			77.9(6.9)	27.4 (1.5)	72¥						~57(5):17(0):23(5) ‡			
Higher GI	22 (0M:22F)			80.2(1.4)	27.6 (0.3)	95¥						~57(5):17(0):22(5) ‡			
Philippou et al. 2008	13 (5M:8F)**	≥1 CHD risk factors, OP					NR	UK	P	Negative	12		500kcal CR; Ad libitum	Agency	
Low GI	7 (3M:4F)		54 (49-58)¶¶	81.5 (4.7)***	28.7 (2.1)***	51.3(51.0-52.0): 105.6 (76.9-110.1)¶¶						46.0(37.8-51.0): 17.1(15.7-17.4): 32.8(31.3-37.1)¶¶			
Higher GI	6 (2M:4F)		45 (39-50)¶¶	89.7 (12.8)***	31.5 (4.4)***	59.3(59.2-64.0): 114.7(98.5-134.9)¶¶						49.4(47.8-51.7):19.6(14.0-23.1):29.2(25.2-34.5)¶¶			

Supplement Table S4c: Trial characteristics continued

Overweight/Obese Trials continued														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Bellisile et al. 2007	65 (0M:65F)**	OW/OB, OP						NR	France	P	Neutral	12	Ad libitum	Industry
Low GI	35		46.1 (13.6)	80 (13.2)	30.2 (4.1)	na								
Higher GI	30		45.3 (12.0)	79 (13.1)	30.4 (4.4)	na								
de Rougemont et al. 2007	38 (22M:16F)**	OW, OP					2.8	France	P	Neutral	5		Ad libitum, some foods provided	Agency, Industry
Low GI	19		36.3 (8.7)	77.2 (9.6)	27.5 (1.3)	46.5 (1.3)						42.6 (3.9):19.8 (1.7):37.7 (4.4)		
Higher GI	19		40.4 (9.6)	77.3 (9.2)	27.2 (1.3)	66.3 (2.6)						44.1 (3.5):17.6 (1.7):38.4 (3.1)		
Sichieri et al. 2007	123 (0M:123F)**	OW, OP						NR	Brazil	P	Negative	72	100-300kcal CR; 6-d menu and exchange lists provided	Agency
Low GI	63		37.2 (5.4)*	67.7 (6.6)*	na	21(38): 74(84)						59.5 (6.3): 13.3: 27.2(4.6)		
Higher GI	60		37.5 (5.6)*	68.5 (7.5)*	na	51(28): 199(43)						61.6 (6.2): 12.3: 26.1(4.7)		
McMillian-Price et al. 2006-High Carb	64(16M:48F)	OW/OB, OP						NR	Australia	P	Negative	12	Ad libitum, key foods and meals provided	Agency-Industry
Low GI	32		30.5 (7.9)	87.1 (15.3)	30.6 (4.5)	45 (6):89 (28)						56 (6):19 (0):22 (6)		
Higher GI	32		31.8 (9.6)	86 (10.7)	30.9 (3.4)	70 (6):129 (45)						60 (6):18 (6):19 (6)		
McMillian-Price et al. 2006-High Protein	65(15M:50F)	OW/OB, OP						NR	Australia	P	Negative	12	Ad libitum, key foods and meals provided	Agency-Industry
Low GI	33		34.6 (8.6)	88.4 (17.2)	32.1 (5.2)	44 (6):59 (23)						40 (11):26 (6):28 (6)		
Higher GI	32		30.2 (8.5)	87.7 (16.4)	31.3 (4.5)	59 (6):75 (17)						42 (6):28 (6):27 (6)		
Wolever et al. 2002	24 (5M:19F)**	IGT, OP						NR	Canada	P	Neutral	16	Ad libitum, partial provision	Agency
Low GI	13(3M:10F)		55.2 (10.8)	79.7 (13.1)***	29.7 (4.3)	54.4 (2.5):91.8 (9.4)						54.8 (6.1):19.4 (1.8):24.7 (5.8)		
Higher GI	11(2M:9F)		58.8 (13.3)	76.4 (20.4)***	29.3 (7.3)	59.3 (2.0):96.8 (11.6)						52.8 (6.6):17.4 (2.3):27.9 (6.3)		

Supplement Table S4d: Trial characteristics continued

Diabetes Trials														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Jenkins et al. 2014	141(77M:64F)	T2DM, OP						NR	Canada	P	Neutral	12		Ad libitum, bread supplement Industry Association
Low GI	70 (38M:32F)		59 (10)	85 (20)	30 (5)	~51:53						~38.5:19.8:37.2		
Higher GI	71 (39M:32F)		59 (10)	84 (19)	31 (6)	~62:89						~49.2:19.8:27.4		
Visek et al. 2014	20 (12M:8F)	T2DM, OP	62.7 (5.8)	91.9 (14.1)	32 (4.2)			NR	Czech Republic	C	Neutral	12		Ad libitum Agency
Low GI						49 (48-51)¶¶¶						~37.2:18.0:36.0		
Higher GI						68 (61-72)¶¶¶						~36.2:17.3:40.0		
Jenkins et al. 2012	121 (61M: 60F)	T2DM, OP						NR	Canada	P	Neutral	12		Ad libitum Agency
Low GI	60		58 (10.1)	85.6 (20.1)	31.4 (7.0)	47: 80						45.4:22.8:30.5		
Higher GI	61		61 (7.8)	82.5 (17.2)	29.9 (5.5)	58: 100						48.3:21.4:28.5		
Yusof et al. 2009	100**	T2DM, OP	NR					NR	Malaysia	P	Neutral	12		Ad libitum, key foods provided to lowGI group Agency
Low GI	51			69.12 (13.33)	27.05 (4.91)	57(6): 108(32)						52(4):18(3):30(4)		
Higher GI	49			66.83 (11.50)	26.79 (4.65)	64(5): 131(30)						54(4):17(3):28(5)		
Jenkins et al 2008	210 (125M:82F)	T2DM, OP						NR	Canada	P	Neutral	24		Ad libitum Agency
Low GI	106 (65M:41F)		60 (10)	87.0 (20.0)	30.6 (6.0)	49.4: 91.5						44.0:21.2:33.3		
Higher GI	104 (63M:41F)		61 (9)	87.8 (19.4)	31.2 (5.8)	59.3: 117.9						47.5:20.7:30.5		
Wolever et al. 2008	103	T2DM, OW/OB, OP						NR	Canada	P	Neutral	52		Ad libitum, key foods provided Agency
Low GI	55		60.6 (7.5)*	81.1 (18.7)*	31.6 (4.5)*	55.1 (3.0): 133 (14.8)						51.9 (6.7):20.6(3.0):26.5 (5.9)		
Higher GI	48		60.4 (7.9)*	84.4(18.0)*	30.1 (4.3)*	63.2 (2.8): 135 (20.8)						46.5 (6.2):20.4 (2.8):30.8 (4.8)		

Supplement Table S4e: Trial characteristics continued

Diabetes Trials continued															
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶¶¶¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source	
Jimenez-Cruz et al. 2003	14 (6M:8F)**	T2DM, OP	59 (34)					NR	Mexico	C	Neutral	6		Ad libitum	Industry
Low GI				91.6 (24.3)	32.4 (6.0)	44(3.4): 86(19.8)						60:21:23			
Higher GI				92.6 (25.4)	32.3 (6.0)	56(4.9): 139(27.3)						64:18:20			
Heilbronn et al. 2002	45 (23M:22F)**	T2DM, OW, OP						3.5	Australia	P	Negative	8		CR to1500kcal/d; Ad libitum, partial provision	Unknown
Low GI	24 (11M:13F)		56.0(9.4)	91.7(16.2)		43						58.9 (2.9):22.2 (1.5):17.9 (3.9)			
Higher GI	21 (12M:9F)		57.5(9.6)	93.2 (13.3)		75						60.8 (2.3):21.7 (0.9):17.1 (2.3)			
Fontvieille et al. 1992	18 (12M:6F)	T1DM/T2DM, OP	47.2(11.6)		24.8(2.6)			4.7	France	C	Neutral	5		Ad libitum	Agency, Industry
Low GI						38.1(5.3)						45.8(7.2):18.0(2.5):36.2(6.8)			
Higher GI						64.2(3.1)						44.9(7.3):18.8(1.6):36.3(6.0)			
Fontvieille et al. 1988	8 (4M:4F)	T1DM, OP	43.5 (9.9)		24.1 (6.8)			3.5	France	C	Neutral	3		Ad libitum, partial provision	Agency, Industry
Low GI						46.5(2.5)						46.1 (4.5):17.4 (1.4):35.0 (2.8)			
Higher GI						60.1 (5.1)						45.4 (4.5):16.9 (1.7):36.0 (2.8)			
CHD Trial															
Frost et al. 2004	55 (48M:7F)**	CHD, OP						NR	UK	P	Neutral §§§	12		Ad Libitum	Unknown
Low GI	26 (23M:3F)		63.6 (9.4)	81.2 (12.2)	26.9 (3.3)	50(4):115(39)						49 (5):18 (5):31 (5)			
Higher GI	29 (25M:4F)		61.8 (9)	81.7 (16.7)	28.7 (4.6)	57(4):106(34)						47 (10):18 (5):32 (10)			

Abbreviations: BMI=Body Mass Index; C=Crossover design; Carb=Carbohydrate; CED= carbohydrate exchange diet; CHD= Coronary Heart Disease; CR= calorie restriction; CV=cardiovascular; GI= glycemic index; GL=glycemic load; IGT= impaired glucose tolerance; IP=inpatient; IR= insulin resistant; High Carb= high carbohydrate; HI= hyperinsulinemic; M = male; mo=months; MUFA=monounsaturated fatty acids; na=not available; T1DM=type 1 diabetes mellitus; T2DM = type 2 diabetes mellitus; OB= obese; OH=otherwise healthy; OP = outpatient; OW= overweight; P=Parallel design; SD= standard deviation; F = female; UK= United Kingdom; USA= United States of America; wks=weeks; y= years

§Negative energy balance diets were designed for weight loss, Neutral energy balance diets for weight maintenance, where all diets are isocaloric between test and control groups; §§Energy from carbohydrate: protein: fat for the planned diet or if not planned; §§§ Participants were advised to lose weight if they had a BMI>28kg/m2.

¶ Range of values; ¶¶ median and interquartile range (IQR); ¶¶¶ Actual GI/GL or if not available, planned;

* Calculated before dropout; **Completer Analysis, as used in data analysis; *** completer analysis, data obtained from authors; **** based on less participants than in analysis;

+ approximate based on all study arms; ¥ approximate based on test meals; ‡ approximate based on n=45 from Sloth et al. 2004, the original publication of this study;

‡‡‡ analysis includes weight loss and weight maintenance phases

Supplemental Table S5: Sensitivity analysis of the systematic removal of each trial*

	MD [95% CI], P-value I ² , P-value					
	Body Weight (kg) N=32	BMI (kg/m ²) N=18	Body Fat (%) N=10	Waist Circumference (cm) N=18	Waist-to-hip Ratio N=6	Sagittal Abdominal Diameter (cm) N=3
All studies	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.91	-0.01 [-0.58, 0.56], P=0.98 65%, P=0.003	-0.46 [-1.05, 0.14], P=0.13 62%, P<0.01	-0.00 [-0.01, 0.00], P=0.27 0.00%, P=0.52	-0.09 [-0.34, 0.16], P=0.48 0.00%, P=0.92
Removal of:						
OW/OB						
Pereira et al. 2015	-0.61 [-0.82, -0.39], P<0.01 0.00%, P=0.54	-0.24 [-0.34, -0.14], P<0.01 0.00%, P=0.93	0.19 [-0.25, 0.63], P=0.39 36%, P=0.13	-0.37 [-1.04, 0.31], P=0.28 62%, P<0.01	-0.00 [-0.01, 0.01], P=0.67 0.00%, P=0.58	n/a
Karl et al. 2015	-0.62 [-0.83, -0.41], P<0.01 0.00%, P=0.50	-0.25 [-0.35, -0.16], P<0.01 0.00%, P=0.91	0.10 [-0.51, 0.71], P=0.74 64%, P<0.01	n/a	n/a	n/a
Buscemi et al. 2013	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.86	-0.08 [-0.63, 0.48], P=0.79 64%, P<0.01	-0.46 [-1.06, 0.15], P=0.14 64%, P<0.01	n/a	n/a
Costa et al. 2012	-0.62 [-0.84, -0.41], P<0.01 0.00%, P=0.46	-0.26 [-0.37, -0.16], P<0.01 0.00%, P=0.86	-0.06 [-0.73, 0.61], P=0.86 66%, P<0.01	-0.33 [-0.94, 0.28], P=0.29 59%, P<0.01	n/a	n/a
Jebb et al. 2010 - LowFat	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Larsen et al. 2010 - LowPro	-0.60 [-0.81, -0.38], P<0.01 0.00%, P=0.57	n/a	n/a	-0.45 [-1.09, 0.18], P=0.16 64%, P<0.01	n/a	-0.05 [-0.39, 0.29], P=0.79 0.00%, P=0.86
Jebb et al. 2010- HighMUFA	-0.64 [-0.85, -0.43], P<0.01 0.00%, P=0.65	n/a	n/a	n/a	n/a	n/a
Larsen et al. 2010 - HighPro	-0.62 [-0.83, -0.41], P<0.01 0.00%, P=0.48	n/a	n/a	-0.37 [-1.00, 0.26], P=0.26 62%, P<0.01	n/a	-0.13 [-0.45, 0.19], P=0.42 0.00%, P=0.92
Solomon et al. 2010	-0.63 [-0.84, -0.42], P<0.01	-0.26 [-0.36, -0.16], P<0.01	n/a	n/a	n/a	n/a

	0.00%, P=0.47	0.00%, P=0.88				
Philippou et al. 2009 - 6mth	-0.65 [-0.86, -0.44], P<0.01 0.00%, P=0.59	-0.28 [-0.37, -0.18], P<0.01 0.00%, P=0.97	-0.12 [-0.71, 0.48], P=0.70 65%, P<0.01	-0.55 [-1.15, 0.04], P=0.07 61%, P<0.01	n/a	n/a
Philippou et al. 2009 - 4mth	-0.61 [-0.83, -0.40], P<0.01 0.00%, P=0.48	-0.25 [-0.35, -0.15], P<0.01 0.00%, P=0.89	-0.09 [-0.72, 0.54], P=0.78 66%, P<0.01	-0.44 [-1.08, 0.19], P=0.17 64%, P<0.01	n/a	n/a
Abete et al. 2008	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	n/a	n/a	n/a	n/a	n/a
Philippou et al. 2008	-0.62 [-0.83, -0.42], P<0.01 0.00%, P=0.48	-0.26 [-0.35, -0.16], P<0.01 0.00%, P=0.89	-0.06 [-0.68, 0.55], P=0.84 68%, P<0.01	-0.41 [-1.02, 0.19], P=0.18 63%, P<0.01	n/a	n/a
Aston et al. 2008	-0.66 [-0.87, -0.44], P<0.01 0.00%, P=0.52	n/a	-0.00 [-0.70, 0.69], P=0.99 68%, P<0.01	-0.54 [-1.14, 0.07], P=0.08 62%, P<0.01	n/a	n/a
Jensen et al. 2008	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.27 [-0.36, -0.17], P<0.01 0.00%, P=0.88	n/a	-0.44 [-1.05, 0.18], P=0.16 64%, P<0.01	-0.00 [-0.01, 0.00], P=0.24 0.00%, P=0.41	-0.09 [-0.35, 0.18], P=0.51 0.00%, P=0.69
de Rougemont et al. 2007	-0.57 [-0.80, -0.34], P<0.01 0.00%, P=0.53	-0.25 [-0.36, -0.14], P<0.01 0.00%, P=0.87	0.06 [-0.57, 0.70], P=0.84 67%, P<0.01	n/a	n/a	n/a
Sichieri et al. 2007	-0.66 [-0.88, -0.45], P<0.01 0.00%, P=0.53	n/a	n/a	n/a	n/a	n/a
Bellisle et al. 2007	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.88	n/a	-0.47 [-1.08, 0.13], P=0.13 64%, P<0.01	-0.00 [-0.01, 0.00], P=0.14 0.00%, P=0.70	n/a
McMillan-Price et al. 2006 - HighCHO	-0.61 [-0.82, -0.39], P<0.01 0.00%, P=0.51	n/a	n/a	-0.38 [-1.01, 0.25], P=0.23 63%, P<0.01	n/a	n/a
McMillan-Price et al. 2006 - HighPro	-0.70 [-0.91, -0.49], P<0.01 0.00%, P=0.91	n/a	n/a	-0.62 [-1.19, -0.05], P=0.03 55%, P<0.01	n/a	n/a
Wolever et al. 2002	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Diabetes:						
Visek et al. 2014	-0.63 [-0.84, -0.42], P<0.01	-0.26 [-0.36, -0.16], P<0.01	0.01 [-0.57, 0.60], P=0.96	n/a	n/a	n/a

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	0.00%, P=0.46	0.00%, P=0.86	68%, P<0.01			
Jenkins et al. 2014	-0.66 [-0.88, -0.43], P<0.01 0.00%, P=0.47	-0.29 [-0.39, -0.18], P<0.01 0.00%, P=0.94	n/a	-0.61 [-1.18, -0.04], P=0.04 50%, P=0.01	-0.00 [-0.01, 0.00], P=0.21 0.00%, P=0.43	n/a
Jenkins et al. 2012	-0.62 [-0.84, -0.40], P<0.01 0.00%, P=0.46	-0.25 [-0.35, -0.15], P<0.01 0.00%, P=0.87	n/a	-0.44 [-1.05, 0.17], P=0.16 64%, P<0.01	-0.00 [-0.01, 0.01], P=0.64 0.00%, P=0.53	n/a
Yusof et al. 2009	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.87	n/a	-0.33 [-0.95, 0.28], P=0.29 58%, P<0.01	n/a	n/a
Jenkins et al. 2008	-0.61 [-0.83, -0.40], P<0.01 0.00%, P=0.48	-0.25 [-0.36, -0.15], P<0.01 0.00%, P=0.87	n/a	n/a	n/a	n/a
Wolever et al. 2008	-0.64 [-0.84, -0.43], P<0.01 0.00%, P=0.57	n/a	n/a	-0.50 [-1.10, 0.09], P=0.10 62%, P<0.01	n/a	n/a
Jimenez-Cruz et al. 2003	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.35, -0.16], P<0.01 0.00%, P=0.86	n/a	n/a	n/a	n/a
Heilbronn et al. 2002	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	n/a	n/a	n/a	n/a	n/a
Fontvieille et al. 1992	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Fontvielle et al. 1988	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
CHD						
Frost et al. 2004	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	-0.26 [-0.36, -0.17], P<0.01 0.00%, P=0.89	n/a	-0.48 [-1.09, 0.12], P=0.12 63%, P<0.01	-0.00 [-0.01, 0.00], P=0.25 1%, P=0.40	n/a

*Sensitivity analysis included the removal of each single study from the meta-analyses one at a time and the summary effect was recalculated. An influential outlier was considered a study whose removal changed the magnitude of the pooled effect by >10%.

BMI, body mass index; CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; MD, mean difference; mnth, month; MUFA, monounsaturated fatty acids; n/a, not applicable; OB, obese; OW, overweight; Pro, protein

Supplemental Table S6: Sensitivity analyses of the use of correlation coefficients of 0.25 and 0.75 for crossover trials

Outcome (no. crossover trials/total)	MD (95% CI), P-value I ² , P-value		
	Correlation Coefficient used in the Primary Analysis	Correlation Coefficient used in Sensitivity Analyses	
	0.5	0.25	0.75
Body Weight, kg (6*/32)	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.63 [-0.84, -0.43], P<0.01 0.00%, P=0.51
BMI, kg/m ² (3/18)	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.91	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.90	-0.26 [-0.35, -0.17], P<0.01 0.00%, P=0.90
Body Fat, % (3*/10)	-0.01 [-0.58, 0.56], P=0.98 65%, P<0.01	-0.00 [-0.58, 0.58], P=0.99 64%, P<0.01	-0.02 [-0.57, 0.54], P=0.96 66%, P<0.01
Waist Circumference, cm (2*/18)	-0.46 [-1.05, 0.14], P=0.13 62%, P<0.01	-0.44 [-1.04, 0.15], P=0.14 60%, P<0.01	-0.46 [-1.07, 0.14], P=0.13 65%, P<0.01
Waist-to-hip Ratio (0/6)	-0.00 [-0.01, 0.00], P=0.27 0.00%, P=0.52	n/a	n/a
Sagittal Abdominal Diameter, cm (0/6)	-0.09 [-0.34, 0.16], P=0.48 0.00%, P=0.92	n/a	n/a

* one of these crossover trials, however, did not require the use of a correlation coefficient as complete data was available

BMI, body mass index; CI, confidence interval; MD, mean difference; no., number

Supplement Table S7. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on body weight (kg)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	24.1 – 37.1 kg/m ²	32	2448	-0.04 (-0.13, 0.06)	0.00%	0.454
Follow-up	3 – 72 wks	32	2448	0.01 (-0.01, 0.02)	0.00%	0.314
Dose Pasta	1.75 – 7.0 serv/wk	11	740	0.29 (-0.91, 1.50)	0.00%	0.595
GI ³	21 - 72	31	2383	-0.01 (-0.04, 0.02)	0.45%	0.482
Difference in GI ²	4.9 - 40.2	31	2383	-0.00 (-0.04, 0.03)	2.75%	0.811
Fiber ³	8.0 - 39.4g/d	27	1851	0.02 (-0.01, 0.06)	0.00%	0.221
Change in Fiber ⁴	-7.5 - +13.8g/d	17	1571	-0.02 (-0.07, 0.04)	23.13%	0.595
Difference in Fiber ²	-8.5 - +15.3g/d	27	1851	-0.01 (-0.06, 0.04)	0.00%	0.701
Saturated Fat ³	5.1 - 12.5%	14	1396	-0.05 (-0.30, 0.20)	34.32%	0.648
Change in Saturated Fat ⁴	-8.2 - -1.2%	12	1309	-0.01 (-0.29, 0.28)	46.27%	0.965
Difference in Saturated Fat ²	-2.0 - +2.3%	14	1396	-0.34 (-1.08, 0.39)	32.80%	0.329
CHO ³	37.2 - 68.0%	30	2345	-0.01 (-0.05, 0.03)	0.00%	0.541
Change in CHO ⁴	-7.2 - +10.1%	19	2046	-0.07 (-0.12, -0.01)	0.00%	0.016
Difference in CHO ²	-11.1 - +5.4%	30	2345	0.02 (-0.05, 0.10)	0.00%	0.547
Protein ³	13.3 - 26.1%	30	2345	0.04 (-0.04, 0.12)	0.00%	0.332

Change in Protein ⁴	-0.5 - +8.6%	19	2046	0.15 (0.03, 0.27)	0.00%	0.017
Difference in Protein ²	-2.5 - +3.4%	30	2345	-0.18 (-0.38, 0.02)	0.00%	0.069
Fat ³	16.0 - 37.7%	30	2345	0.01 (-0.05, 0.06)	0.00%	0.852
Change in Fat ⁴	-12.2 - +5.4%	19	2046	0.05 (-0.02, 0.12)	17.73%	0.122
Difference in Fat ²	-4.4 - +10.6%	30	2345	0.02 (-0.05, 0.09)	0.00%	0.610

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in body weight on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in body weight. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index

Supplemental Table S8. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on BMI (kg/m²)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 37.1 kg/m ²	18	1038	-0.01 (-0.06, 0.03)	0.00%	0.559
Follow-up	4 – 24 wks	18	1038	0.00 (-0.01, 0.02)	0.00%	0.559
Dose Pasta*	2.33 – 7.0 serv/wk	4	143			
GI ³	39.8 - 72	17	973	0.01 (-0.01, 0.03)	0.00%	0.153
Difference in GI ²	7.0 - 40.2	17	973	-0.01 (-0.03, 0.01)	0.00%	0.275
Fiber ³	8.0 - 39.4g/d	16	935	0.01 (-0.01, 0.02)	0.00%	0.366
Change in Fiber ⁴	-1.8 - +12.4g/d	10	758	0.00 (-0.03, 0.03)	0.00%	0.846
Difference in Fiber ²	-4.9 - +13.0g/d	16	935	-0.00 (-0.02, 0.02)	0.00%	0.821
Saturated Fat* ³	7.6 - 12.5%	7				
Change in Saturated Fat* ⁴	-2.4 - -1.2%	6				
Difference in Saturated Fat* ²	-1.0 - +2.3%	7				
CHO ³	37.2 - 68.0%	16	935	-0.00 (-0.02, 0.01)	0.00%	0.594
Change in CHO ⁴	-5.6 - +3.2%	10	758	-0.02 (-0.06, 0.02)	0.00%	0.325
Difference in CHO ²	-11.1 - +2.0%	16	935	-0.01 (-0.03, 0.02)	0.00%	0.531
Protein ³	13.9 – 22.8%	16	935	0.00 (-0.04, 0.04)	0.00%	0.905

Change in Protein ⁴	-0.2 - +3.0%	10	758	0.01 (-0.11, 0.14)	0.00%	0.786
Difference in Protein ²	-2.5 - +3.4%	16	935	-0.03 (-0.12, 0.06)	0.00%	0.441
Fat ³	16.0 - 37.7%	16	935	0.00 (-0.02, 0.02)	0.00%	0.717
Change in Fat ⁴	-4.8 - +5.4%	10	758	0.02 (-0.02, 0.06)	0.00%	0.240
Difference in Fat ²	-4.4 - +10.6%	16	935	0.01 (-0.01, 0.04)	0.00%	0.299

*For Dose, there were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in BMI on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in BMI. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplemental Table S9. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on body fat (%)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 36.0 kg/m ²	10	285	-0.02 (-0.26, 0.23)	67.69%	0.890
Follow-up	4 – 24 wks	10	285	0.06 (-0.06, 0.17)	66.00%	0.303
Dose Pasta*	2.33 - 3.33 serv/wk	3	96			
GI ³	39.8 - 72	10	285	0.12 (-0.00, 0.25)	52.21%	0.053
Difference in GI ²	7.0 - 40.2	10	285	-0.09 (-0.15, -0.03)	19.39%	0.008
Fiber* ³	8.0 - 39.4g/d	8	228			
Change in Fiber* ⁴	-1.8 - +12.4g/d	4	87			
Difference in Fiber* ²	-4.9 - +13.0g/d	8	228			
Saturated Fat* ³	7.6 - 12.5%	3	93			
Change in Saturated Fat* ⁴	-2.4 - -1.2%	2	51			
Difference in Saturated Fat* ²	-1.0 - +2.3%	3	93			
CHO* ³	37.2 - 68.0%	9	247			
Change in CHO* ⁴	-5.6 - +3.2%	4	87			
Difference in CHO* ²	-11.1 - +2.0%	9	247			
Protein* ³	13.9 – 22.8%	9	247			

Change in Protein* ⁴	-0.2 - +3.0%	4	87		
Difference in Protein* ²	-2.5 - +3.4%	9	247		
Fat* ³	16.0 - 37.7%	9	247		
Change in Fat* ⁴	-4.8 - +5.4%	4	87		
Difference in Fat* ²	-4.4 - +10.6%	9	247		

*There were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in body fat on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in body fat. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplemental Table S10. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 36.0 kg/m ²	18	1380	0.10 (-0.13, 0.32)	59.02%	0.372
Follow-up	4 – 52 wks	18	1380	0.05 (-0.03, 0.13)	60.50%	0.225
Dose Pasta*	3.0 – 3.33 serv/wk	2	63			
GI ³	41.2 – 72.0	17	1315	-0.01 (-0.12, 0.10)	66.00%	0.841
Difference in GI ²	4.9 – 32.9	17	1315	-0.02 (-0.10, 0.06)	64.51%	0.596
Fiber ³	8.0 - 39.4g/d	15	1258	0.05 (-0.05, 0.14)	59.60%	0.342
Change in Fiber ⁴	-1.8 - +13.8g/d	13	1176	0.01 (-0.17, 0.20)	70.59%	0.861
Difference in Fiber ²	-4.9 - +15.3g/d	15	1258	-0.00 (-0.14, 0.13)	64.86%	0.939
Saturated Fat* ³	6.1 – 10.1%	8	604			
Change in Saturated Fat* ⁴	-7.6 - -1.2%	7	562			
Difference in Saturated Fat* ²	-2.0 - +2.3%	8	604			
CHO ³	38.5 - 58.6%	16	1277	-0.11 (-0.19, -0.04)	27.06%	0.007
Change in CHO ⁴	-7.2 - +10.1%	13	1176	-0.09 (-0.23, 0.04)	57.19%	0.148
Difference in CHO ²	-11.1 - +5.4%	16	1277	-0.01 (-0.18, 0.17)	60.81%	0.947
Protein ³	13.9 – 26.1%	16	1277	0.20 (0.01, 0.38)	43.92%	0.038

Change in Protein ⁴	-0.3 - +8.6%	13	1176	0.19 (-0.09, 0.46)	63.38%	0.165
Difference in Protein ²	-2.5 - +3.4%	16	1277	-0.14 (-0.66, 0.38)	62.79%	0.570
Fat ³	22.0 - 37.2%	16	1277	0.10 (-0.05, 0.26)	53.48%	0.185
Change in Fat ⁴	-12.2 - +5.4%	13	1176	0.08 (-0.07, 0.24)	61.15%	0.274
Difference in Fat ²	-4.4 - +10.6%	16	1277	0.09 (-0.06, 0.25)	47.17%	0.220

*There were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in waist circumference on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in waist circumference. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplementary Table S11. Post-hoc piecewise linear continuous dose-response meta-regression analyses for the effect of pasta intake in the context of low-GI dietary patterns on body weight (kg)

Dose threshold of servings of pasta consumed per week	Dose ranges of servings of pasta consumed per week	β (95% CIs) *	Residual I^2 †	<i>p</i>-value
3.0	≤ 3.0	-0.70 (-3.27, 1.86)	0.00%	0.890
	> 3.0	0.91 (-0.89, 2.70)		
3.33	≤ 3.33	0.05 (-1.80, 1.89)	0.00%	0.518
	> 3.33	0.44 (-1.75, 2.63)		
3.5	≤ 3.5	0.09 (-1.65, 1.82)	0.00%	0.888
	> 3.5	0.46 (-1.89, 2.81)		

* β is the slope derived from the piecewise linear meta-regression analyses and represents the treatment effect on body weight for doses above and below each dose-threshold representing servings of pasta consumption per week; † The residual I^2 value indicates heterogeneity unexplained by each dose-threshold.

Supplementary Table S12: GRADE assessment of study quality

Quality assessment*							№ of patients		Effect	Quality Importance
№ of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Pasta/LGI diet	Higher GI diet	Absolute (95% CI)	
Body Weight (follow up: median 12 weeks)										
32	randomised trials	not serious	not serious	serious ^a	not serious	none	1294	1228	MD -0.63 kg (-0.84 to -0.42)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
BMI (follow up: median 12 weeks)										
18	randomised trials	not serious	not serious	serious ^a	not serious	none	551	538	MD -0.26 kg/m² (-0.36 to -0.16)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
Waist Circumference (follow up: median 12 weeks)										
18	randomised trials	not serious	serious ^b	serious ^a	not serious	none	717	624	MD -0.46 cm (-1.05 to 0.14)	⊕⊕○○ LOW ^{a,b} Due to downgrade for inconsistency and indirectness

Quality assessment*							№ of patients		Effect	Quality Importance
№ of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Pasta/LGI diet	Higher GI diet	Absolute (95% CI)	
Body Fat (follow up: median 12 weeks)										
10	randomised trials	not serious	serious ^c	serious ^a	not serious	none	176	165	MD -0.01 % (-0.58 to 0.56)	⊕⊕○○ LOW ^{a,c} Due to downgrade for inconsistency and indirectness
Waist-to-hip Ratio (follow up: median 12 weeks)										
6	randomised trials	not serious	not serious	serious ^a	not serious	none ^d	223	222	MD -0.00 (-0.01 to 0.00)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
Sagittal Abdominal Diameter (follow up: median 26 weeks)										
3	randomised trials	not serious	not serious	serious ^a	not serious	none ^d	237	214	MD -0.09 cm (-0.34 to 0.16)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness

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3 CI, Confidence interval; GI, glycemic index; LGI, low glycemic index; MD, Mean difference
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6 *All outcomes started with high quality evidence since all studies were randomized controlled trials. Risk of Bias –We rated down for
7 risk of bias if the majority of studies were considered to be at high risk of bias. Inconsistency – We assessed inconsistency using I^2
8 estimates where an I^2 of 50% or higher indicates substantial heterogeneity. I^2 is the percentage of variability in the treatment estimates
9 that is attributable to heterogeneity between studies. We rated down for inconsistency if there was substantial heterogeneity that was
10 unexplained by any a priori sensitivity or subgroup analyses. Indirectness – We rated down for indirectness if there were factors
11 present relating to the population, interventions, and outcomes that limited the generalizability of the results. Imprecision – We rated
12 down for imprecision if the 95% confidence interval (95% CI) crossed the minimally important difference (MID) for harm. MIDs used
13 for each outcome are: 0.5kg for body weight (based on Johnston et al. JAMA 2014;312(9):923-33); 0.2kg/m² for BMI; 2.0cm for
14 waist circumference; 2.0% for body fat; 0.02 for waist-to-hip ratio; 2.0cm for sagittal abdominal diameter.
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17 a. Downgrade for serious indirectness, since most of the available trials did not quantify the amount of pasta consumed in the context
18 of the low-GI dietary patterns
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20 b. Downgrade for serious inconsistency, as there was evidence of substantial inter-study ($I^2=62%$, P-heterogeneity<0.001), which
21 could not be explained
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23 c. Downgrade for serious inconsistency, as there was evidence of substantial inter-study ($I^2= 65%$, P-heterogeneity=0.003), which
24 could not be explained
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26 d. No downgrade for publication bias, as publication bias could not be assessed due to lack of power for assessing funnel plot
27 asymmetry and small study effects (<10 trials included in the meta-analysis)
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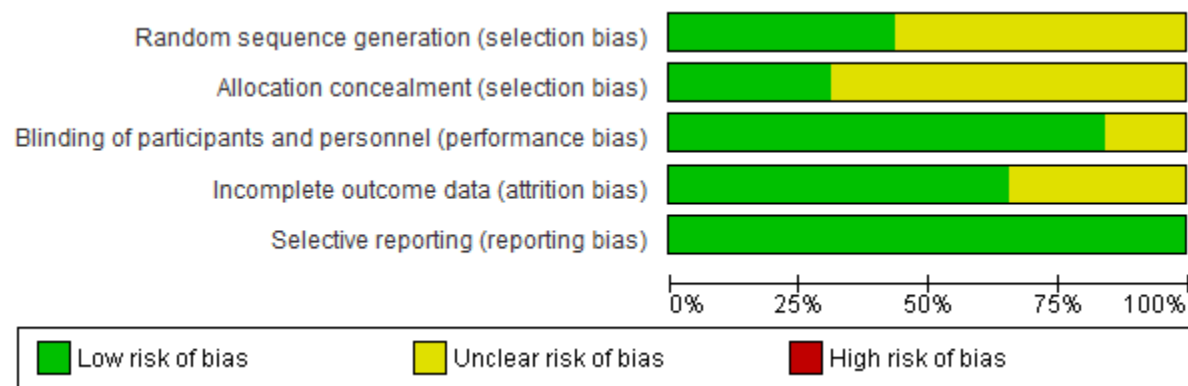
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Supplemental Figures

	Random Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel and Outcome Assessment	Incomplete Outcome Data	Selective Reporting		Random Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel and Outcome Assessment	Incomplete Outcome Data	Selective Reporting
Abete et al. 2008	?	?	?	+	+	Jimenez-Cruz et al. 2003	?	?	?	?	+
Aston et al. 2008	+	?	+	+	+	Karl et al. 2015	+	+	+	+	+
Bellisle et al. 2007	?	?	?	?	+	Larsen et al. 2010 -LowPro	+	+	+	+	+
Buscemi et al. 2012	+	+	+	?	+	Larsen et al. 2010 -HighPro	+	+	+	+	+
Cost et al. 2012	?	?	+	+	+	McMillan-Price et al. 2006- HighCHO	?	?	+	+	+
de Rougemont et al. 2007	?	+	+	+	+	McMillan-Price et al. 2006- HighPro	?	?	+	+	+
Fontvielle et al. 1992	?	?	+	+	+	Pereira et al. 2015	?	?	+	?	+
Fontvielle et al. 1988	?	?	+	+	+	Philippou et al. 2008	?	?	+	?	+
Frost et al. 2004	?	?	+	+	+	Philippou et al. 2009-4mo	?	?	+	?	+
Heilbronn et al. 2002	?	?	+	?	+	Philippou et al. 2009-6mo	?	?	?	?	+
Jebb et al. 2010 - HighMUFA	+	?	+	?	+	Sicheri et al. 2007	+	?	+	?	+
Jebb et al. 2010 - LowFat	+	?	+	?	+	Solomon et al. 2010	?	?	+	+	+
Jenkins et al. 2014	+	+	+	+	+	Visek et al. 2014	?	?	+	+	+
Jenkins et al. 2012	+	+	+	+	+	Wolever et al. 2008	+	+	?	+	+
Jenkins et al. 2008	+	+	+	+	+	Wolever et al. 2002	+	+	+	+	+
Jensen et al. 2008	?	?	+	+	+	Yusof et al. 2009	+	?	+	+	+

Supplemental Figure S1: Cochrane risk of bias summary for all included trials

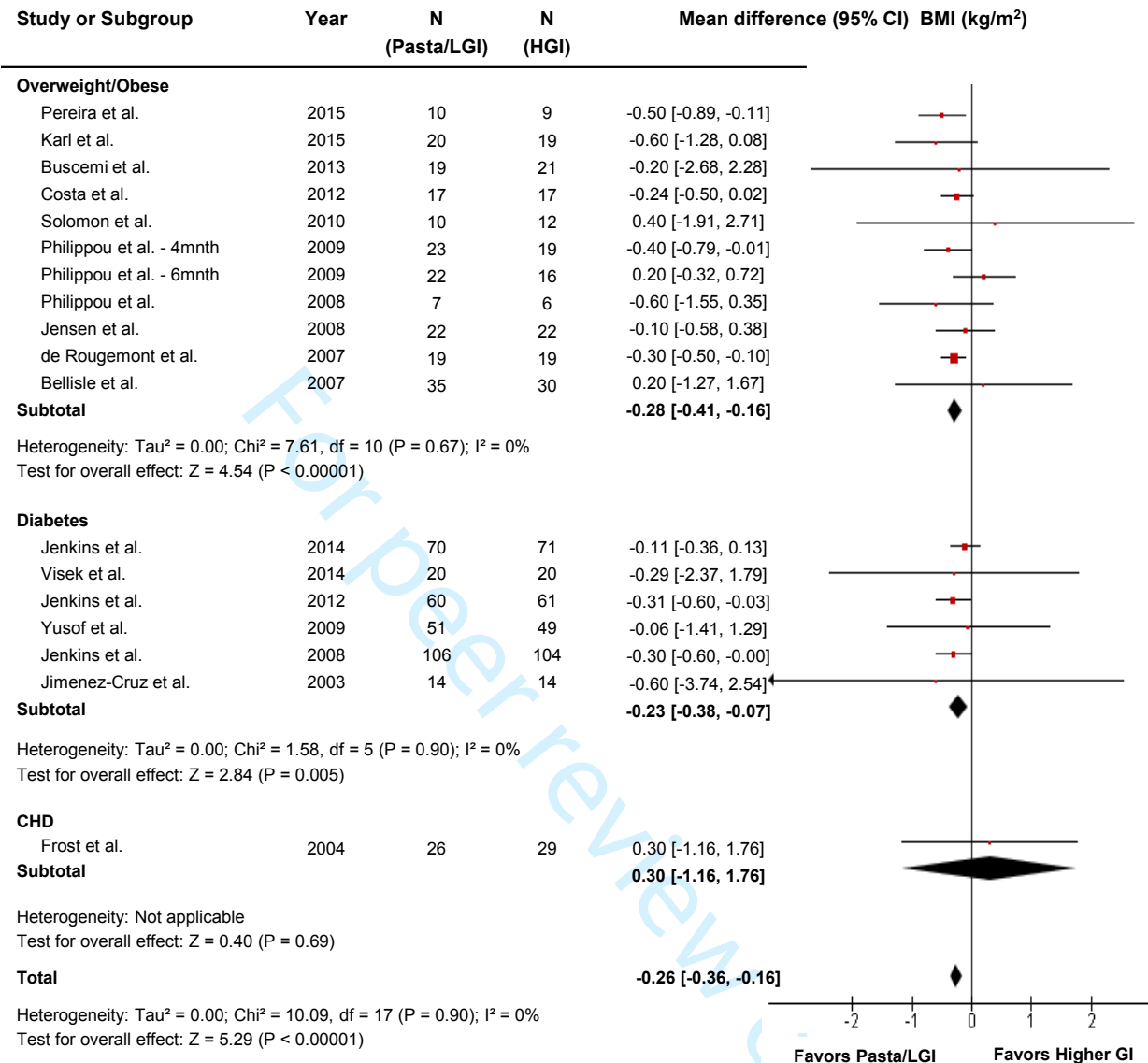
Summary of risk of bias ratings for each individual study included in the meta-analysis.



Supplemental Figure S2: Risk of bias proportion graph for all included trials

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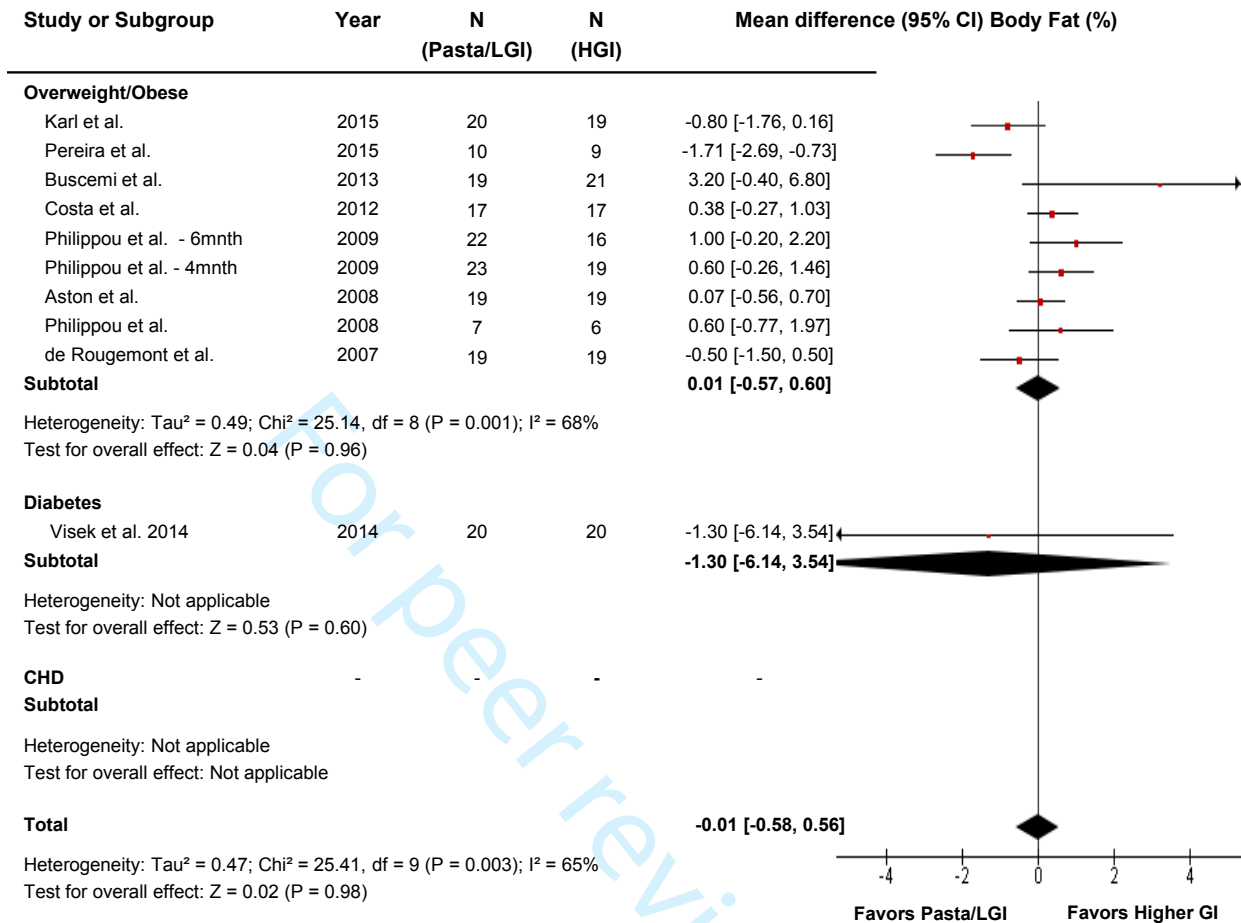
For peer review only



Supplemental Figure S3: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on BMI (kg/m²) (n= 1038)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

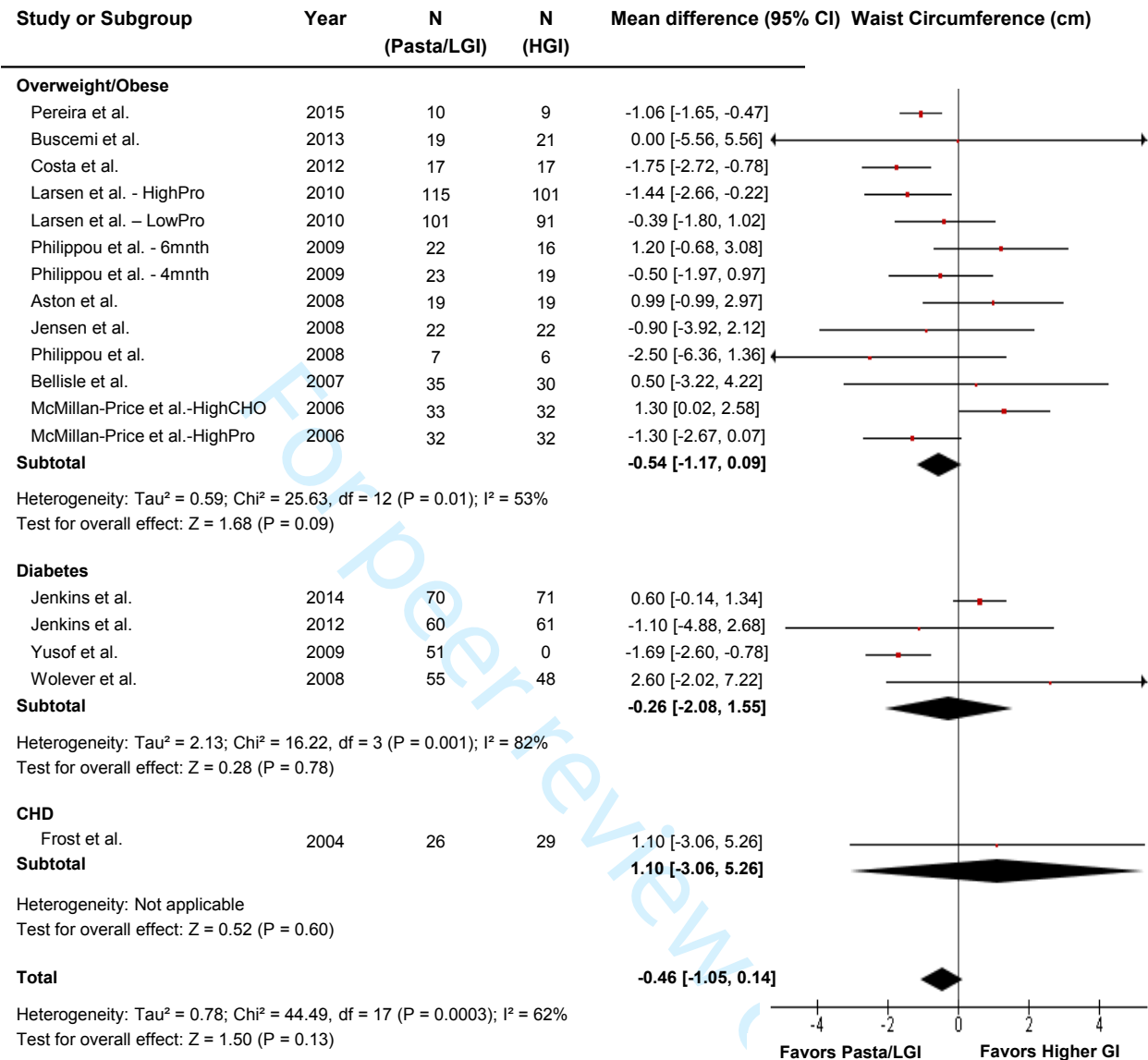
BMI, body mass index; CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S4: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body fat (%) (n= 285)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

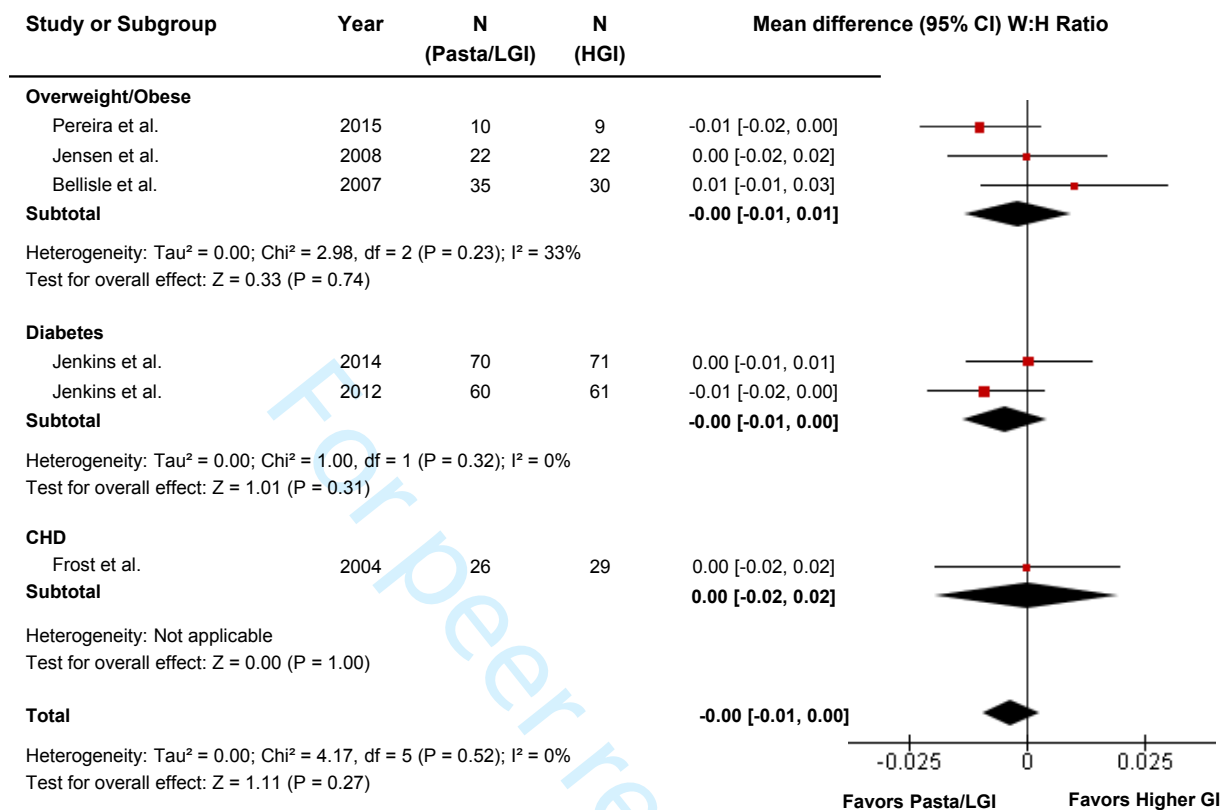
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S5: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

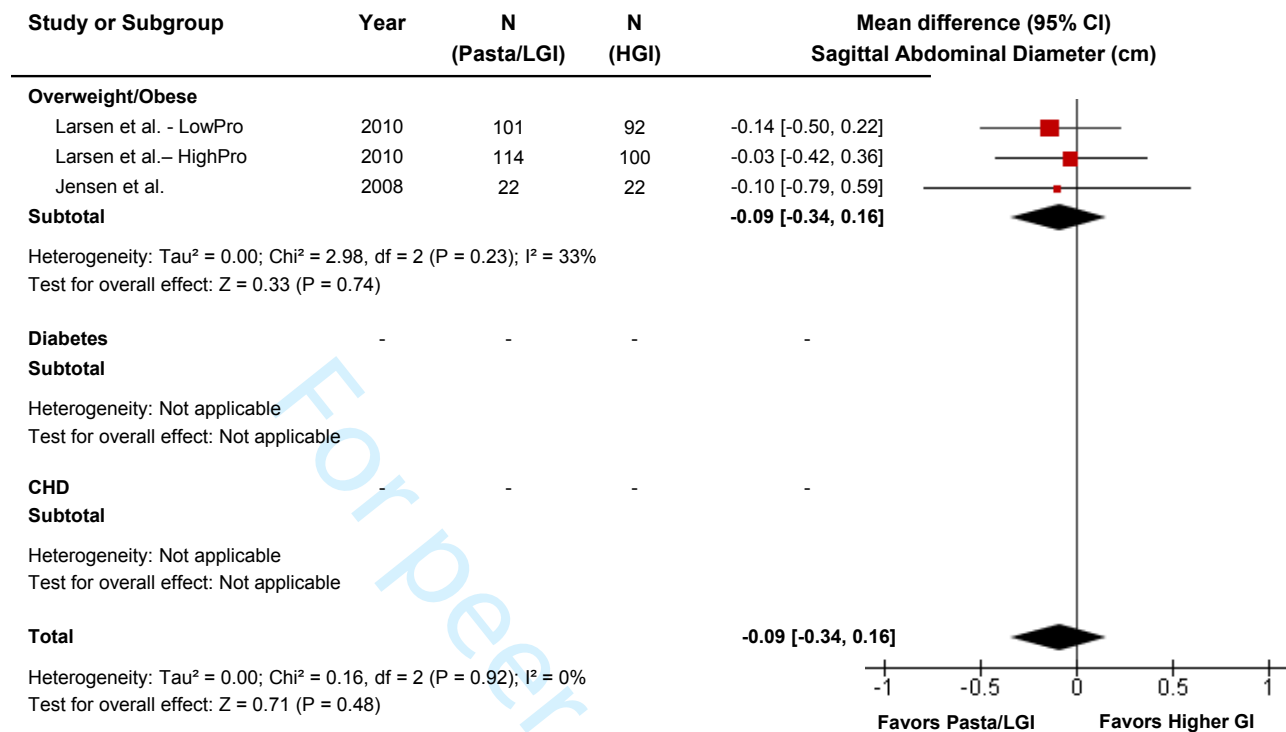
CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; Pro, protein



Supplemental Figure S6: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on waist-to-hip ratio (n = 445)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

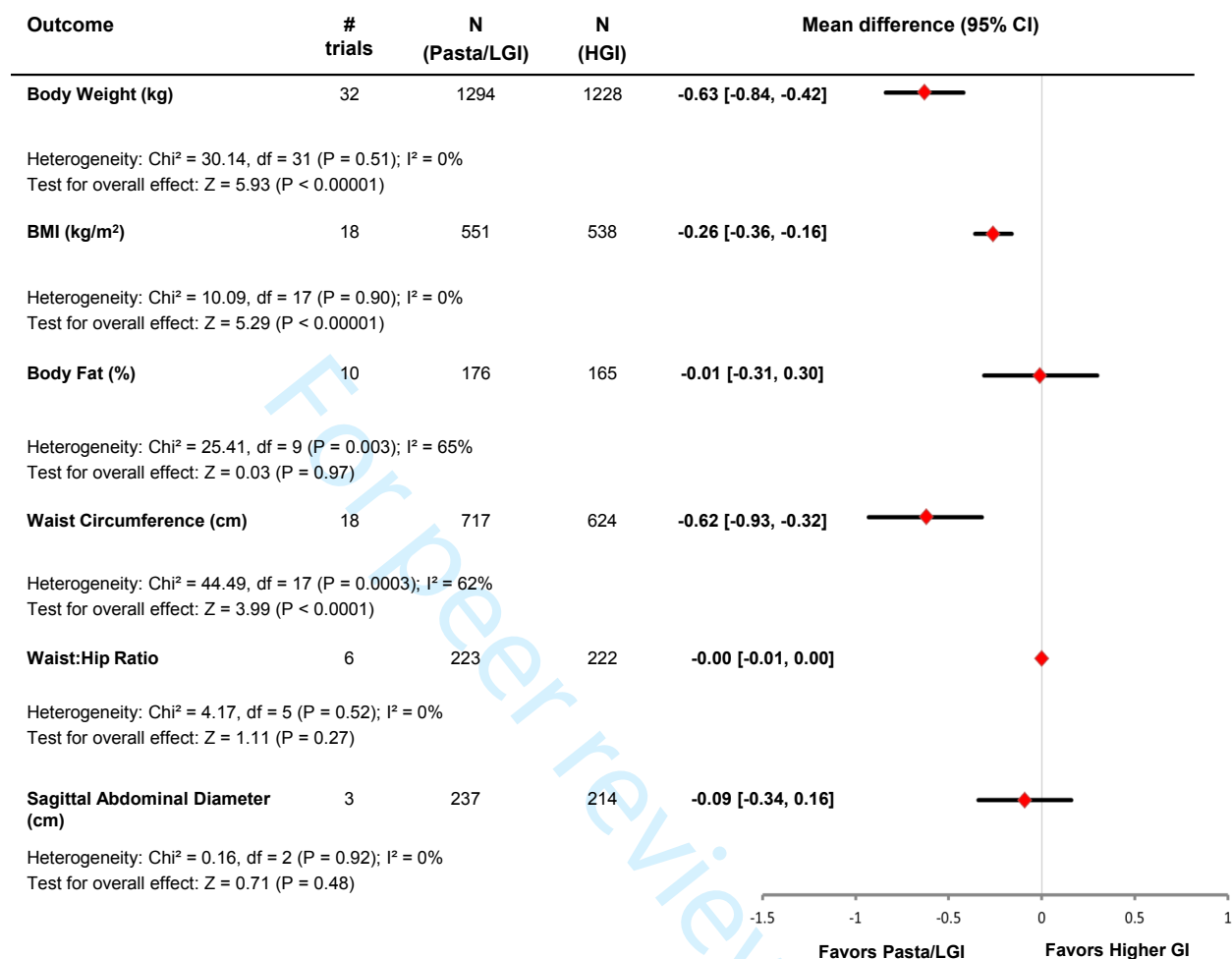
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S7: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on sagittal abdominal diameter (cm) (n = 478)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

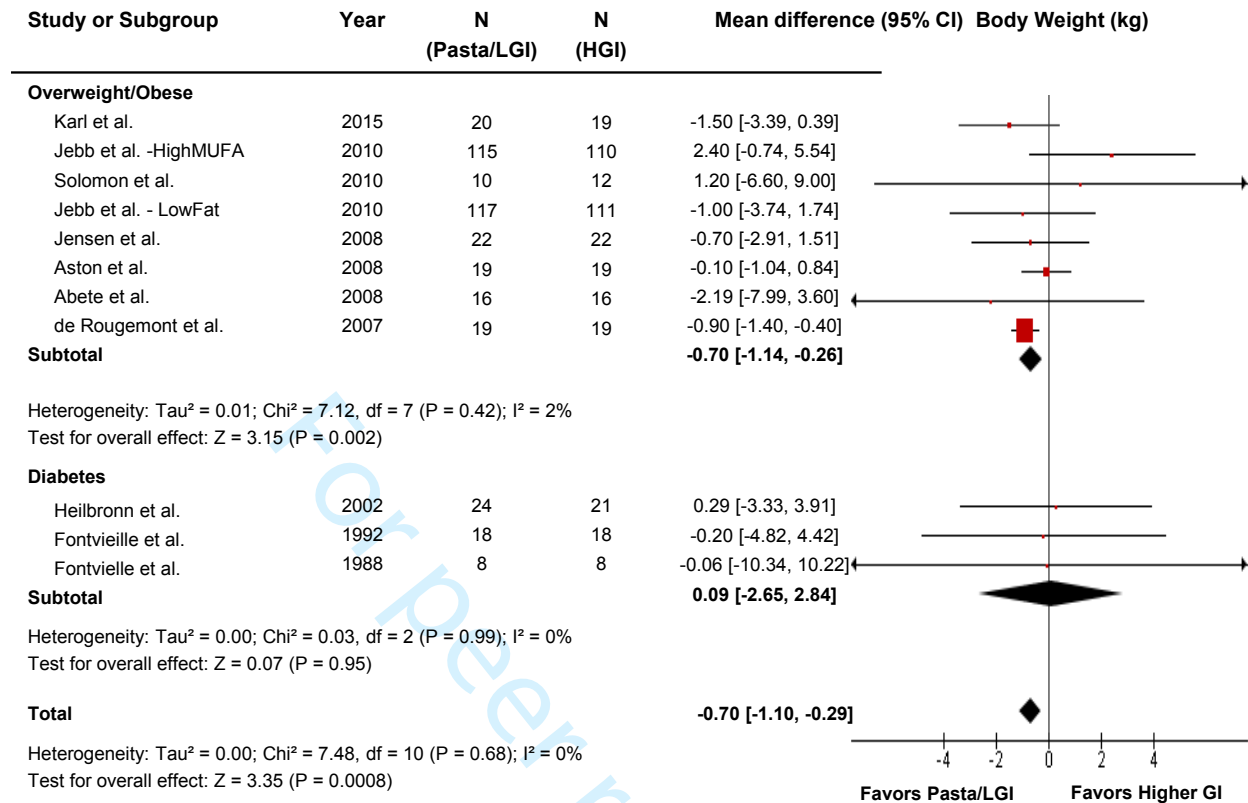
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; Pro, protein



Supplemental Figure S8: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg) using fixed effects models (n = 2448)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance fixed effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids; Pro, protein.

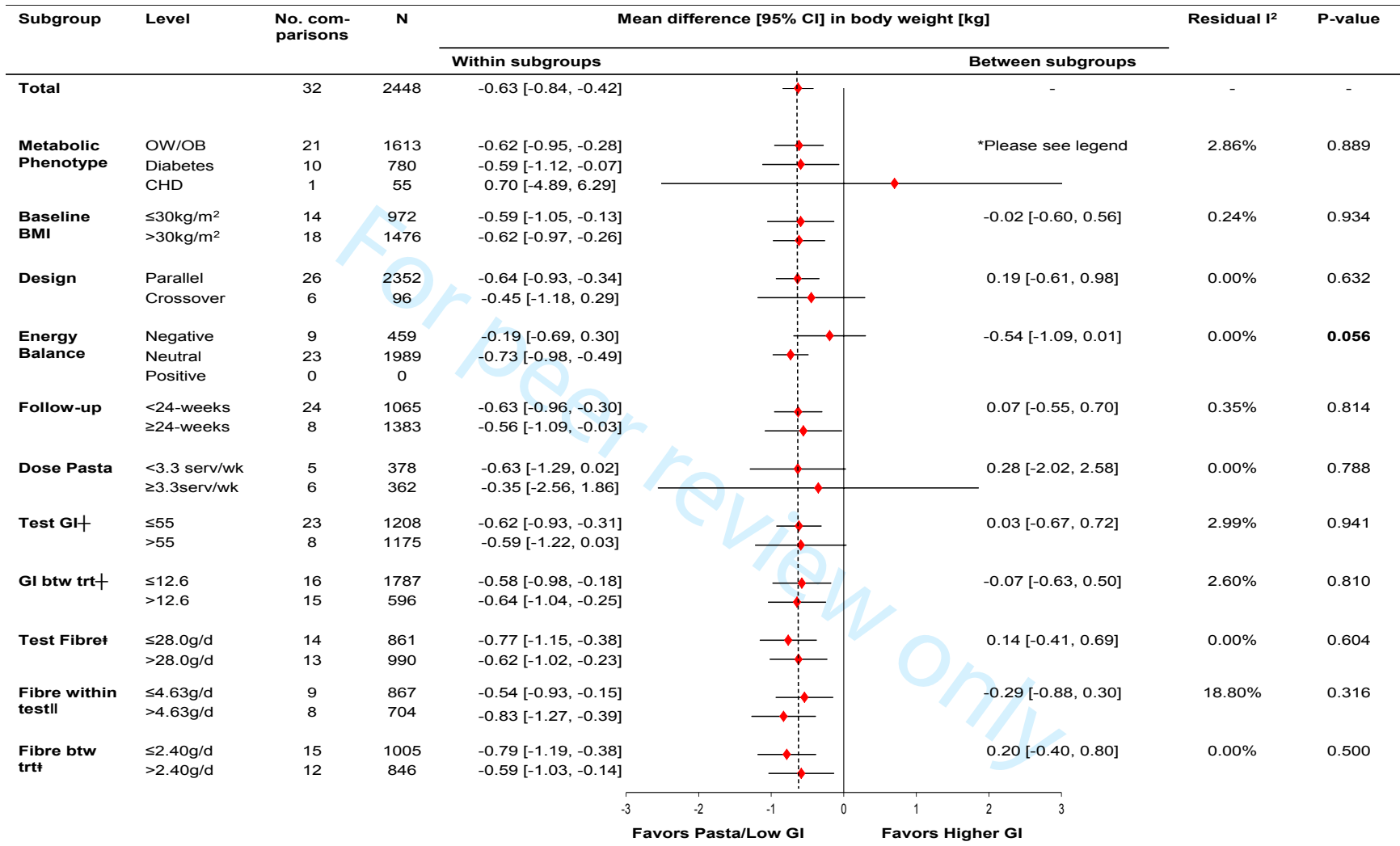


Supplemental Figure S9: Forest plot of randomized controlled trials which contain data for approximating pasta intake which are investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 740)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot’s bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran’s Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids

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Supplemental Figure S10: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes.
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11 BMI, body mass index; btw, between; CHD, coronary heart disease; CI, confidence interval; GI, glycemic index (glucose scale); OB,
12 obese; OW, overweight; serv, serving; trt, treatment; wk, week.
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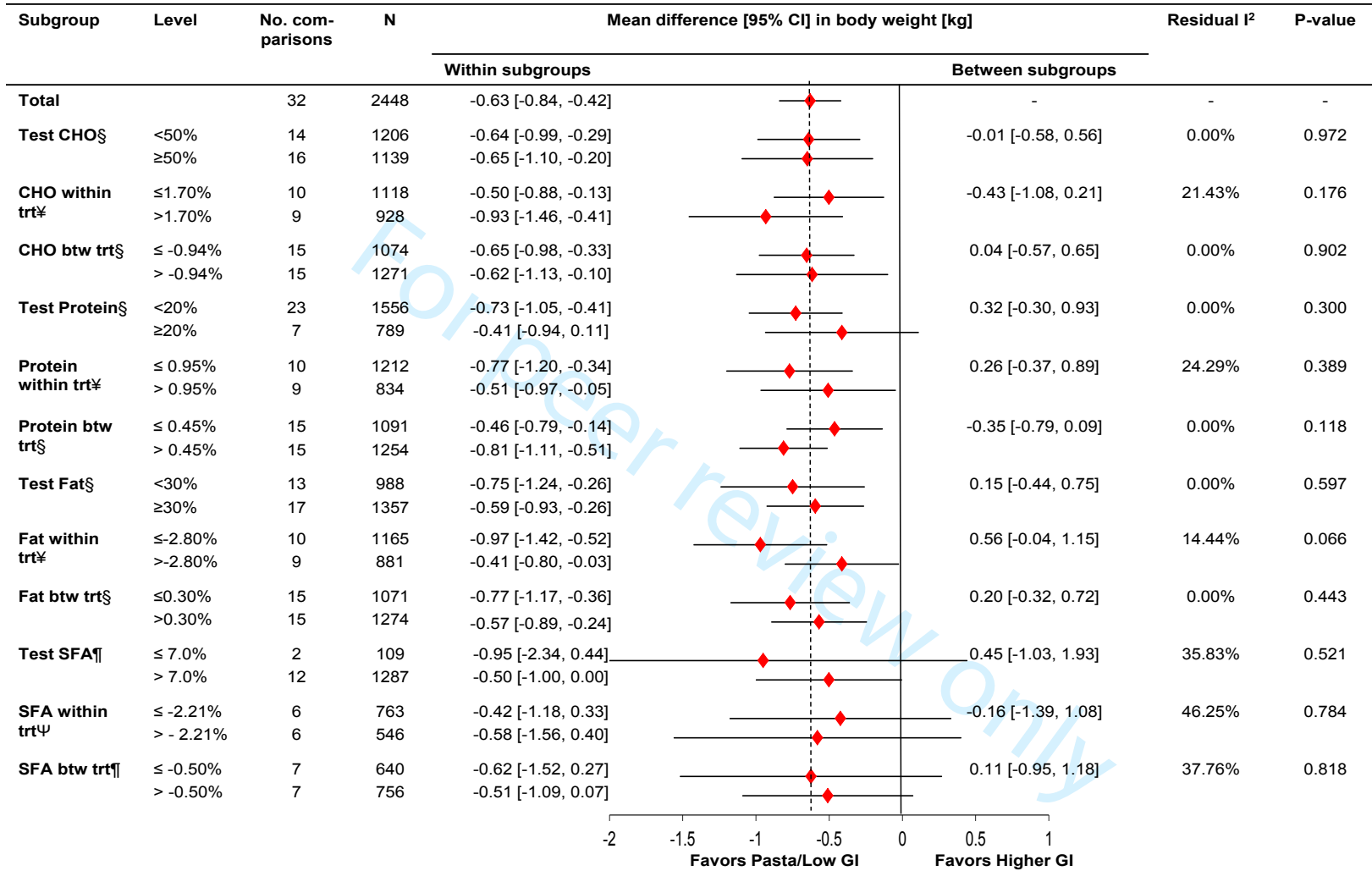
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15 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.02kg (-0.08, 0.65) (1 vs. 2) to
16 1.32kg (-4.28, 6.91) (1 vs. 3) to -1.29kg (-6.91, 4.32) (2 vs. 3).

17 † data available on 31 studies

18 ‡ data available on 17 studies

19 † data available on 27 studies
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Supplemental Figure S11: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body weight (kg) continued (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes.
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11 BMI, body mass index; btw, between; CI, confidence interval; GI, glycemic index (glucose scale); trt, treatment.

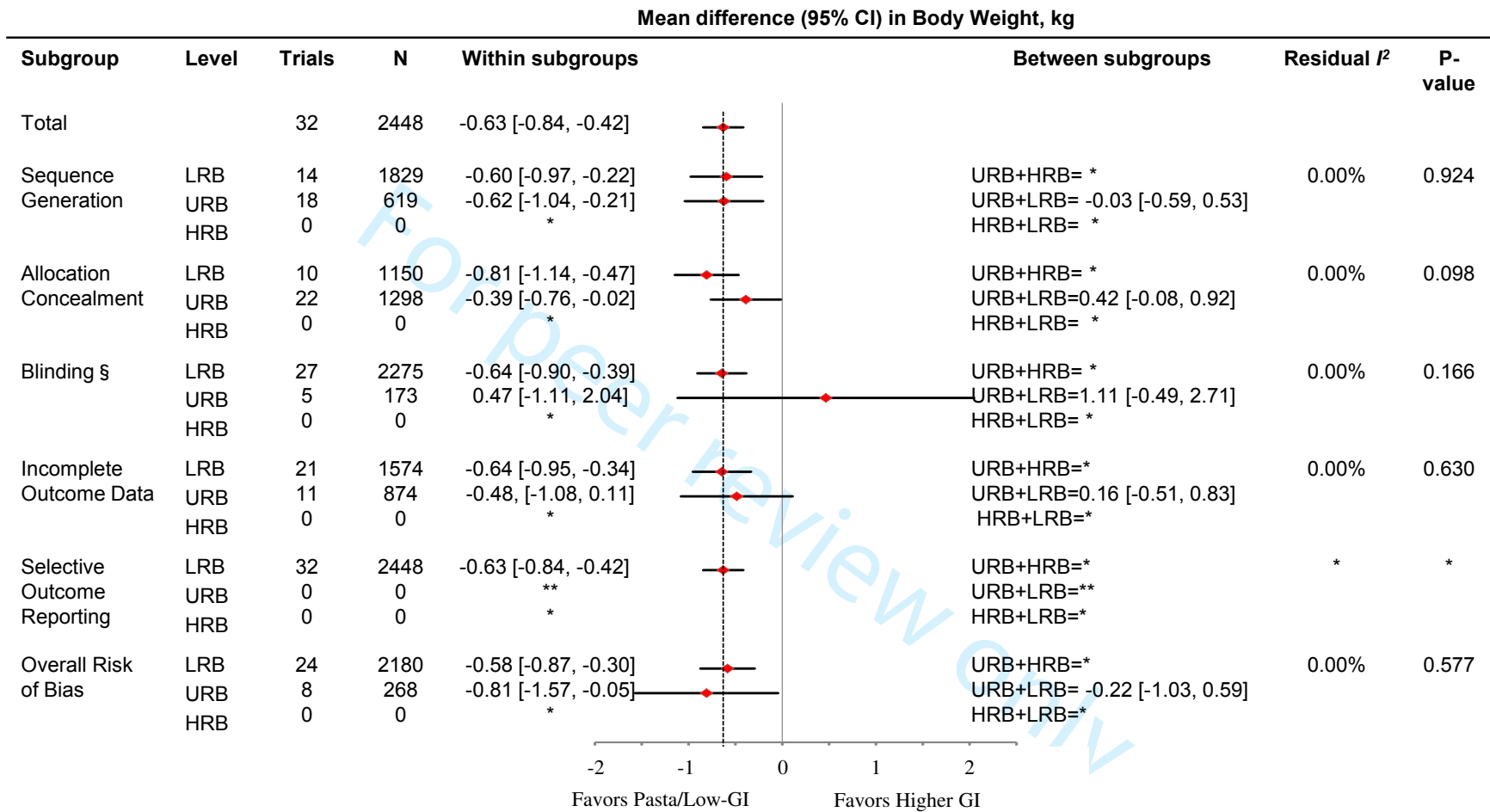
12 § data available on 30 studies

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14 ¶ data available on 14 studies

15 Ψ data available on 12 studies
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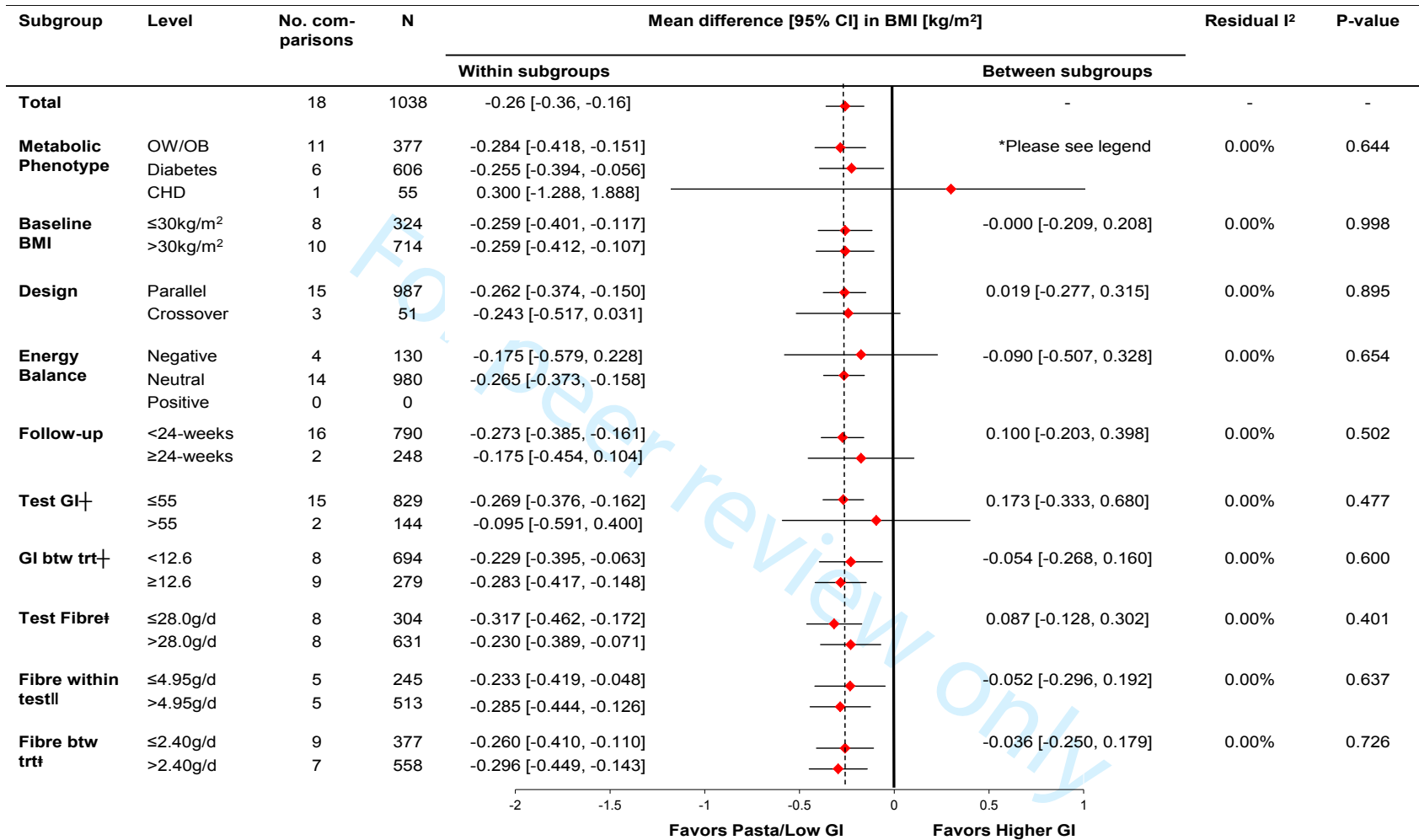


Supplemental Figure S12: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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10 LRB=Low Risk of Bias, URB= Unclear Risk of Bias, HRB=High Risk of Bias. *Within and between subgroup analysis could not be
11 performed against HRB since no values for HRB subgroup. ** no values for URB subgroup. § Blinding of Participants, Personnel,
12 and Outcome Assessors.
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Supplemental Figure S13: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) (n = 1038)

The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line through the square. The residual I² was estimated with the use of the Cochran’s Q statistic and indicates the between study

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3 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
4 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
5 median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=3 trials), therefore analyses
6 were not performed.
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9 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.059kg/m^2 (-0.156, 0.274) (1 vs.
10 2) to 0.584kg/m^2 (-1.009, 2.178) (1 vs. 3) to -0.525kg/m^2 (-2.122, 1.072) (2 vs. 3).
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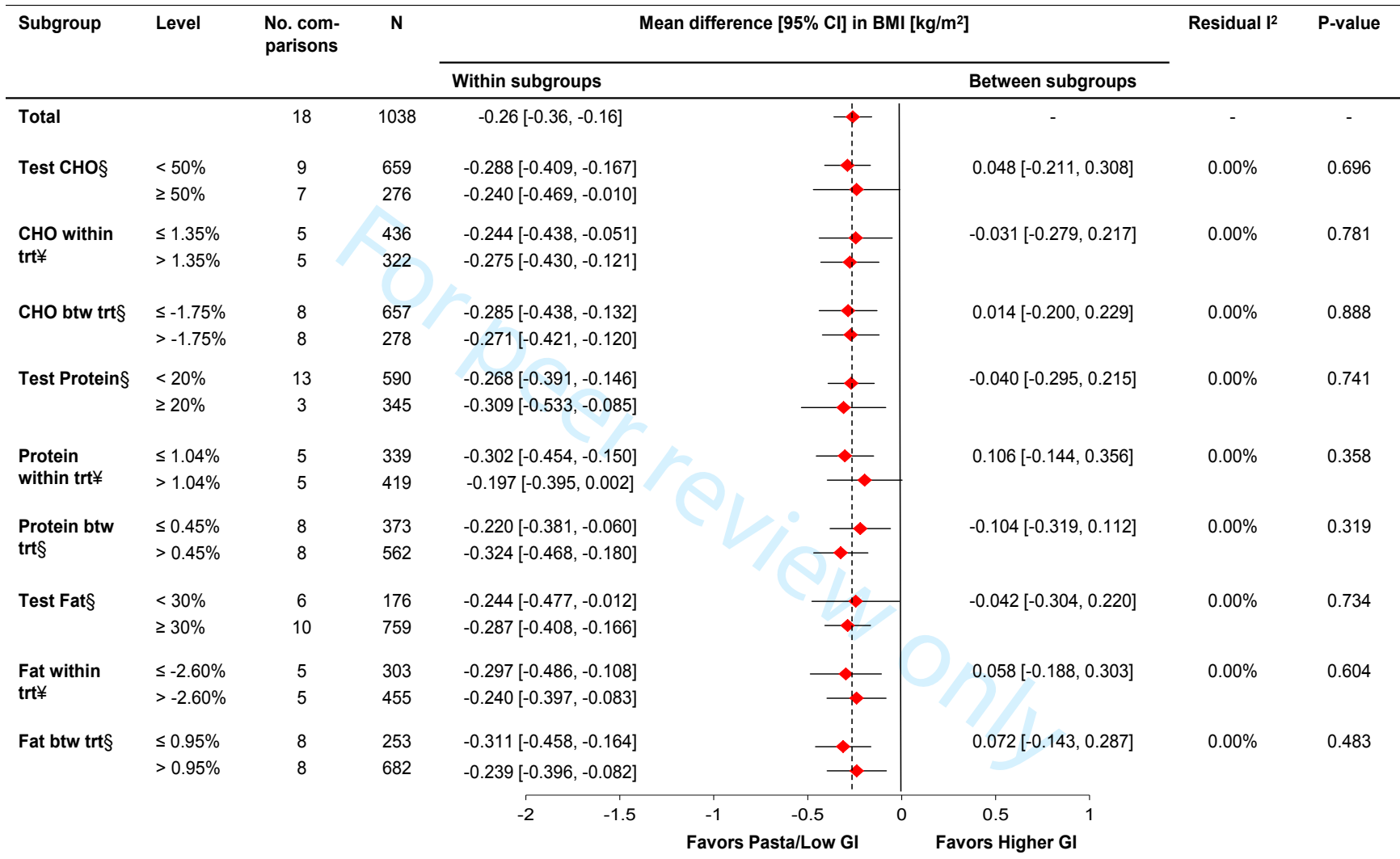
12 † data available on 17 studies

13 ‡ data available on 16 studies

14 ‖ data available on 10 studies
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16 BMI, body mass index; btw, between; CI, confidence interval; GI, glycemic index (glucose scale); OB, obese; OW, overweight; trt,
17 treatment.
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Supplemental Figure S14: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) continued (n = 1038)

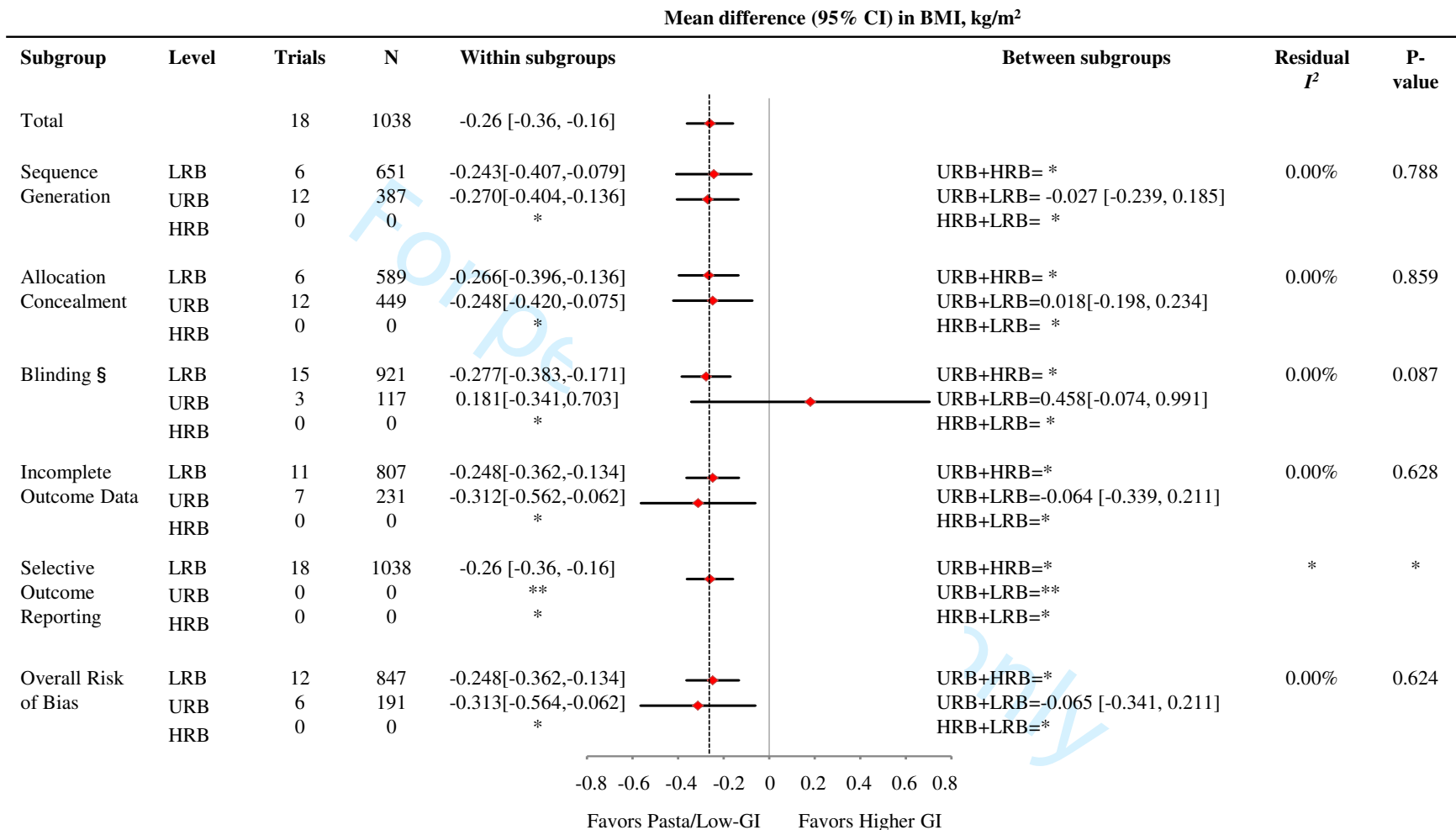
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line
5 through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes. There were less than 10 trials available for categorical subgroup assessment for test saturated fat (n=7 trials), saturated
9 fat within treatment (n=6 trials) and saturated fat between treatments (n=7 trials), therefore analyses were not performed.

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11 § data available on 16 studies

12 ¥ data available on 10 studies
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15 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); trt, treatment.
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Supplemental Figure S15: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) (n = 1038)

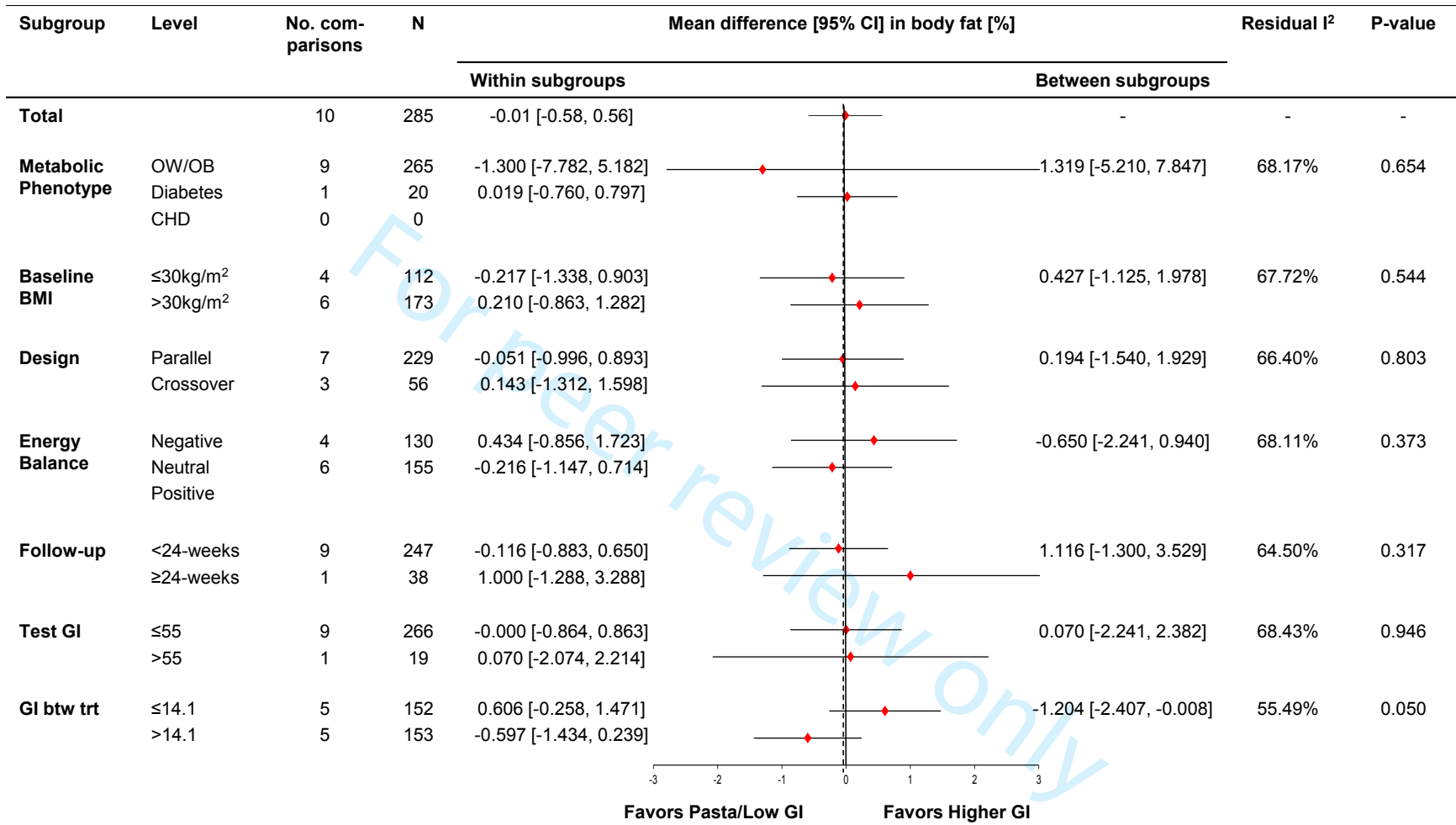
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line
5 through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.
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15 BMI, body mass index; CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear
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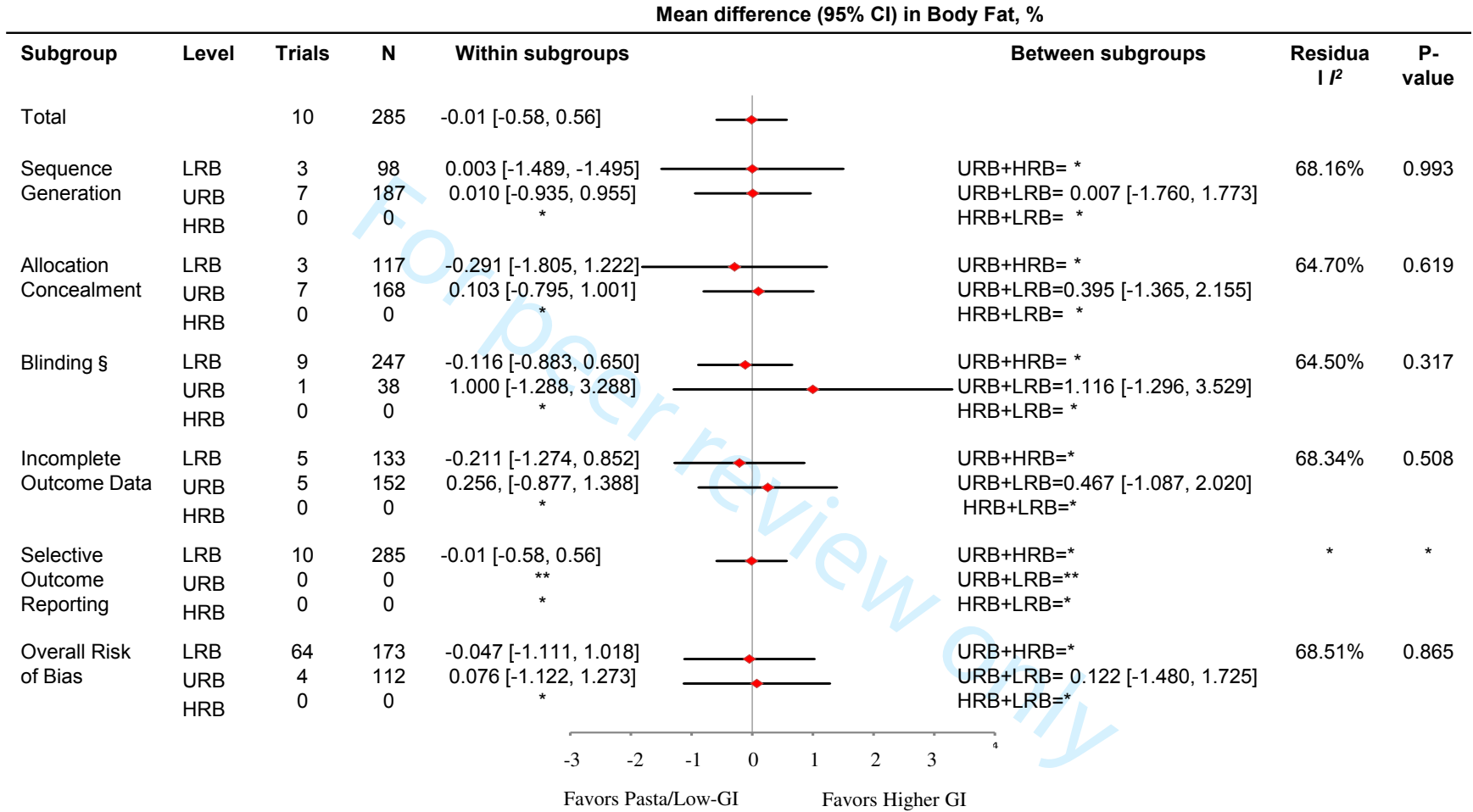


Supplemental Figure S16: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body fat (%) (n = 285)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body fat. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the
5 line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=3), test carbohydrate, protein
9 and fat (n=9), carbohydrate, protein and fat within treatment (n=4), carbohydrate, protein and fat between treatment (n=9), test fibre
10 (n=8), fibre within treatment (n=4), fibre between treatment (n=8), test saturated fat (n=3 trials), saturated fat within treatment (n=2
11 trials) and saturated fat between treatments (n=3 trials), therefore analyses were not performed.
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16 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); OB, obese;
17 OW, overweight; trt, treatment.
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Supplemental Figure S17: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body fat (%) (n = 285)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body fat. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the
5 line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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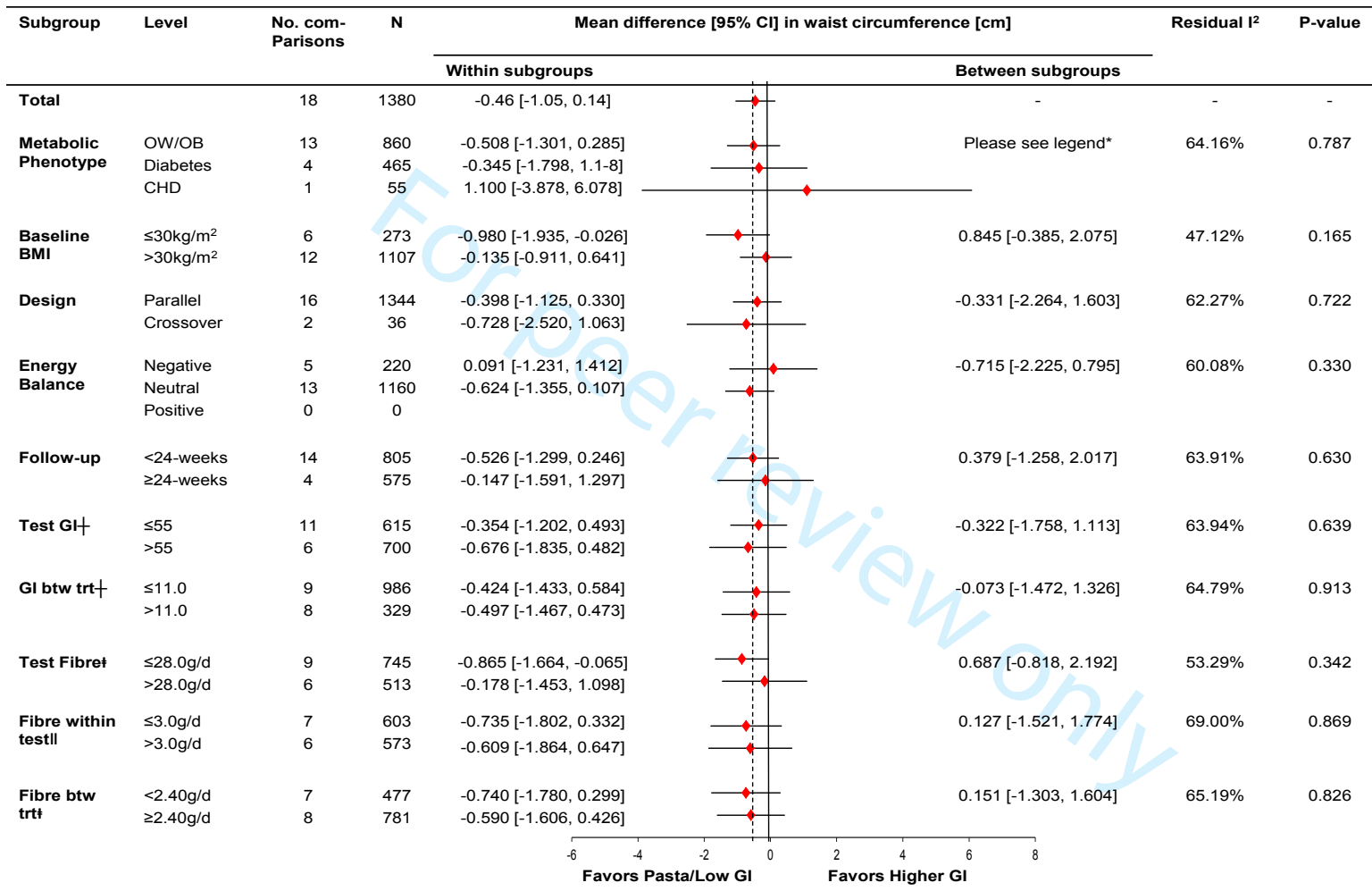
10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.
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15 CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear Risk of Bias
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Supplemental Figure S18: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup. Within and between-treatment changes were categorically
8 assessed based on the median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=2
9 trials), therefore analyses were not performed.
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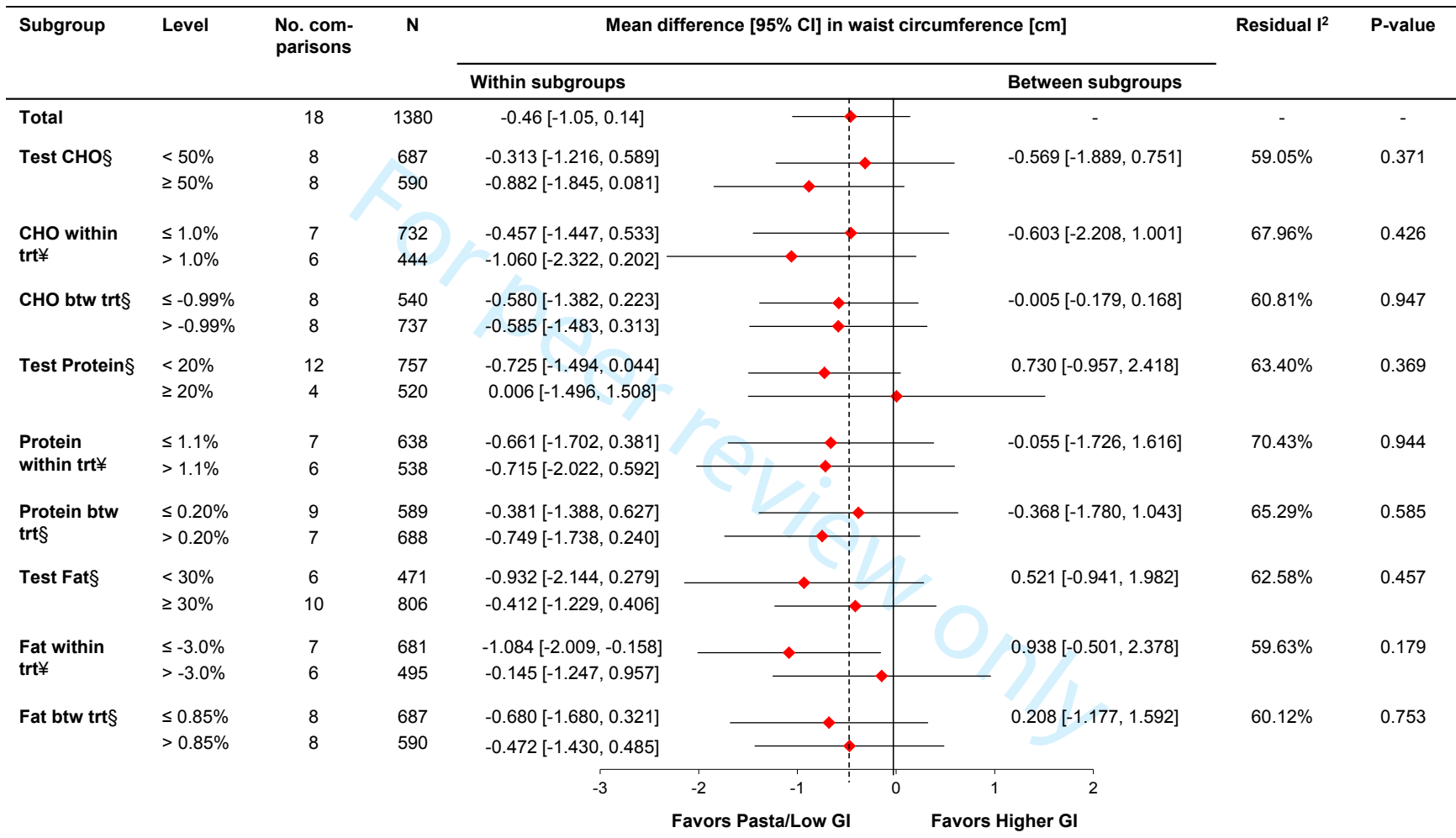
12 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.163cm (-1.492, 1.818) (1 vs. 2)
13 to 1.608cm (-3.432, 6.648) (1 vs. 3) to -1.445cm (-6.630, 3.740) (2 vs. 3).

14 † data available on 17 studies

15 ‡ data available on 15 studies
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18 BMI, body mass index; btw, between; CI = confidence interval; GI, glycemic index (glucose scale); OB, obese; OW, overweight; trt,
19 treatment.
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Supplemental Figure S19: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) continued (n = 1380)

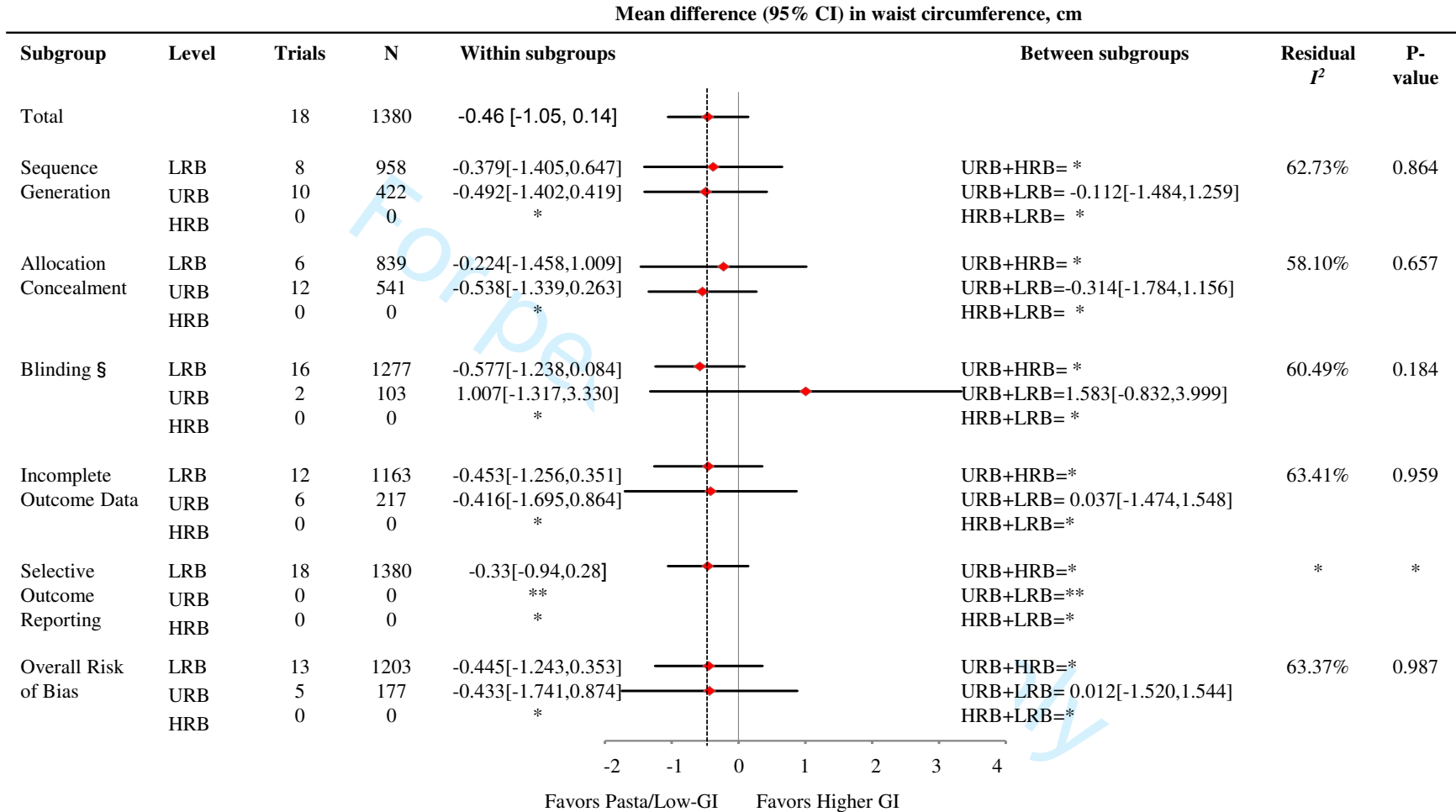
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup. Within and between-treatment changes were categorically
8 assessed based on the median intakes. There were less than 10 trials available for categorical subgroup assessment for test saturated fat
9 (n=8 trials), saturated fat within treatment (n=7 trials) and saturated fat between treatments (n=8 trials), therefore analyses were not
10 performed.
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13 § data available on 16 studies

14 ¥ data available on 13 studies

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17 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); trt, treatment.
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Supplemental Figure S20: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup.
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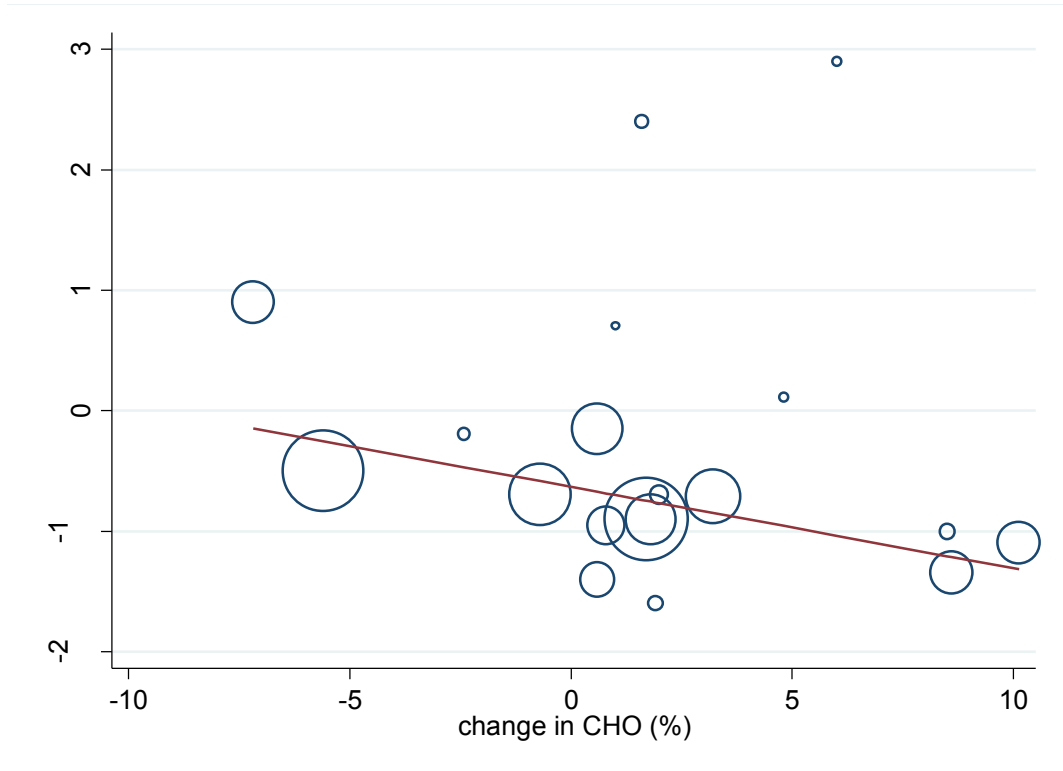
10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

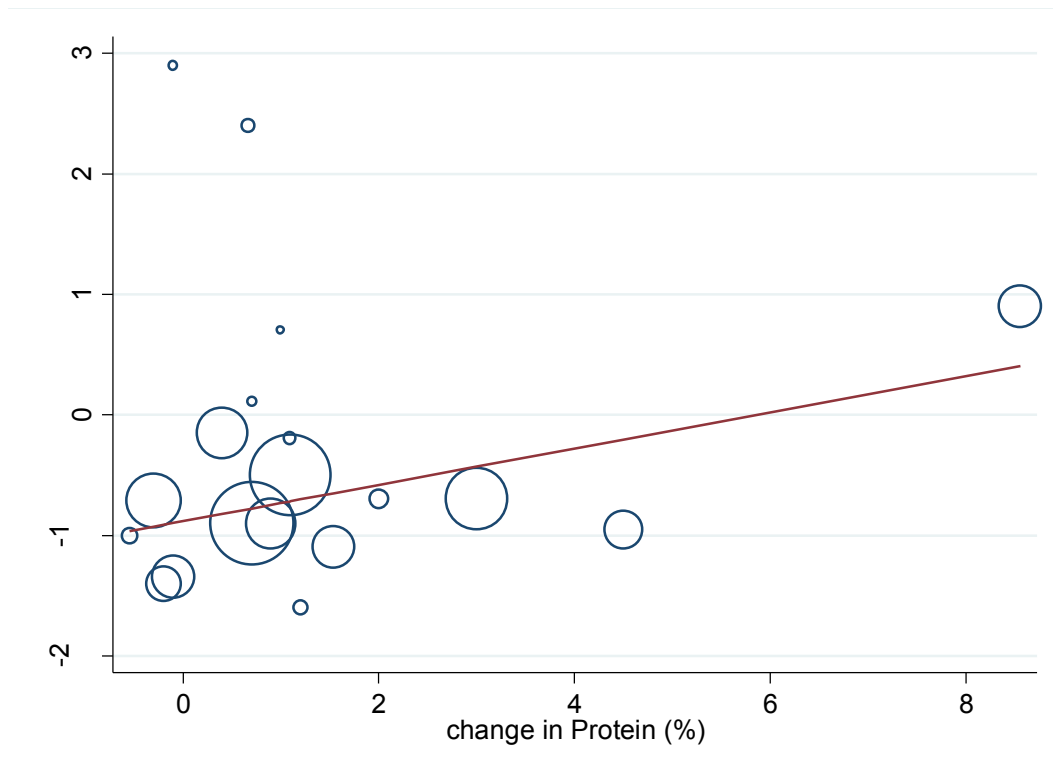
12 § Blinding of Participants, Personnel, and Outcome Assessors.
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15 CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear Risk of Bias
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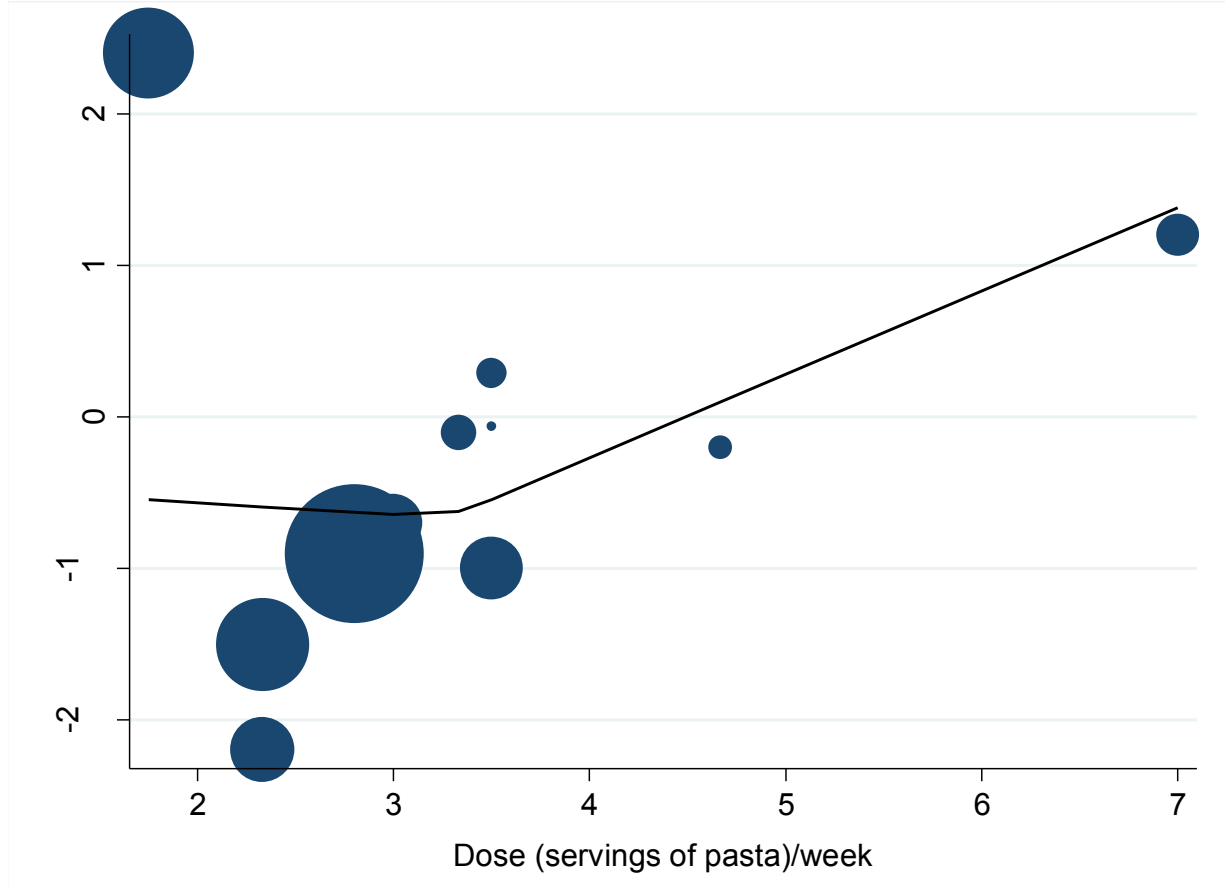


Supplemental Figure S21: Continuous meta-regression of change in carbohydrate intake in the low-GI dietary pattern intervention arms with change in body weight (n=19)
CHO, carbohydrate; MD, mean difference



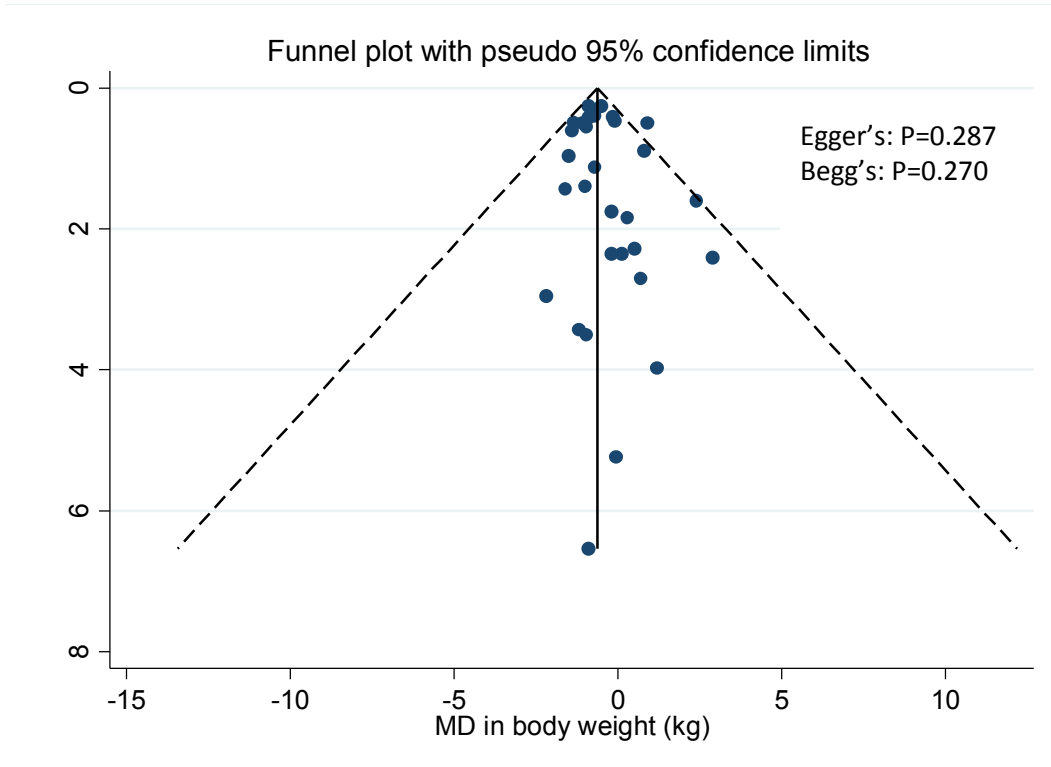
Supplemental Figure S22: Continuous meta-regression of change in protein intake in the low-GI dietary pattern intervention arms with change in body weight (n=19)
 MD, mean difference

review only



Supplemental Figure S23: Pasta intake dose-response analyses by spline curve modeling (MKSPLINE procedure)

view only

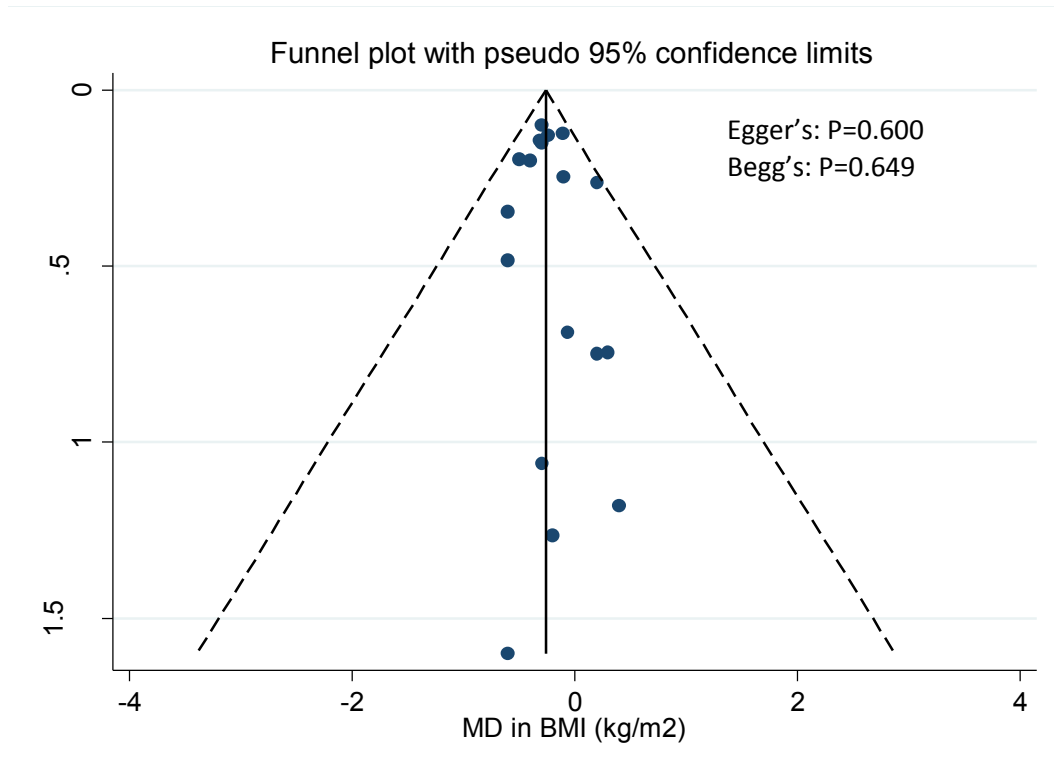


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Supplemental Figure S24: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on body weight (kg)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.

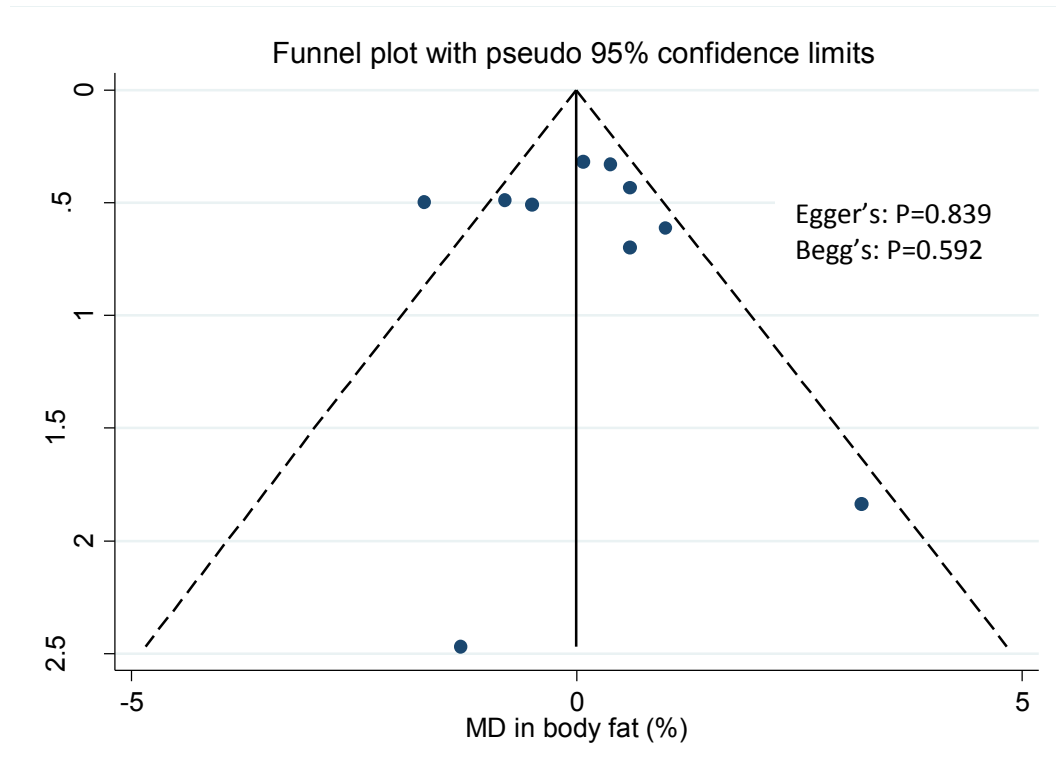


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Supplemental Figure S25: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on BMI (kg/m²)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.

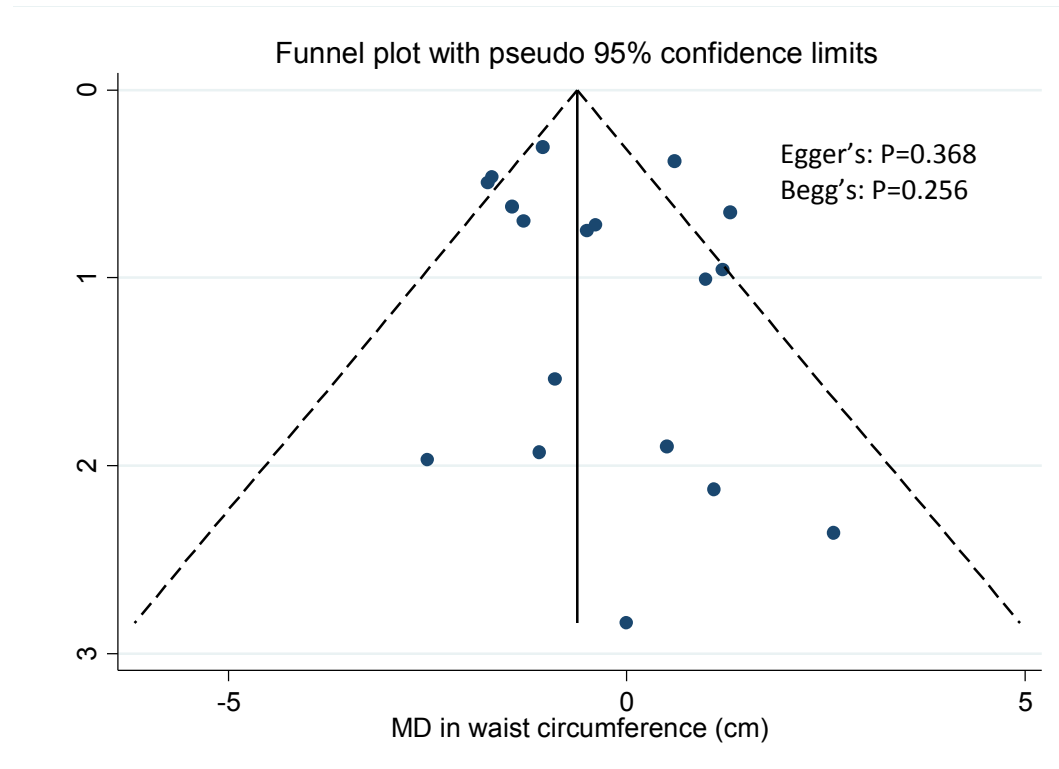


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Supplemental Figure S26: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on body fat (%)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.



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Supplemental Figure S27: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.

Supplemental Table S1: PRISMA Checklist



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	6
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6-7, Supplemental Table S2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6, Supplemental Table S1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplemental Table S1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6-7, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and	7, Supplemental

		simplifications made.	Table S2
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8-10

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	10
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	8-10
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	11, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	11-12, Table 1, Supplemental Tables S2-S3
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	12, Supplemental Figures S1-S2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	12-13, Figures 2-3, Supplemental Figures S3-S7
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	12-13, Figures 2-3, Supplemental Figures S3-S7
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15).	12,16 Supplemental

			Table S1, S2, S12, S15, S17, S20
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	13-16, Supplemental Tables S4-S10, Supplemental Figures S8-S26
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	17-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20-22
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	22-24
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	27-28

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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BMJ Open

Effect of Pasta in the Context of Low Glycemic Index Dietary Patterns on Body Weight and Markers of Adiposity: A Systematic Review and Meta-analysis of Randomized Controlled Trials in Adults

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Keywords:	body weight, pasta, glycemic index, glycaemic index, systematic review and meta-analysis, weight loss

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Manuscripts

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2
3 **1 Effect of Pasta in the Context of Low Glycemic Index Dietary Patterns on Body Weight**
4 **2 and Markers of Adiposity: A Systematic Review and Meta-analysis of Randomized**
5 **3 Controlled Trials in Adults**

6
7
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46 24 **Keywords:** body weight, pasta, glycemic index, glycaemic index, systematic review and meta-

47
48
49 25 analysis, weight loss

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51 26

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55 28

1
2
3 **29 ABSTRACT**
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5 **30 Objective:** Carbohydrate staples such as pasta have been implicated in the obesity epidemic. It
6
7
8 **31** is unclear whether pasta contributes to weight gain or like other low-glycemic index (GI) foods
9
10 **32** contributes to weight loss. We synthesized the evidence of the effect of pasta on measures of
11
12 **33** adiposity.

13
14 **34 Design:** Systematic review and meta-analysis using the GRADE approach.

15
16 **35 Data sources:** MEDLINE, Embase, CINAHL, and the Cochrane Library were searched through
17
18
19 **36** 07 February 2017.

20
21 **37 Eligibility criteria for selecting studies:** We included randomized controlled trials ≥ 3 -weeks
22
23 **38** assessing the effect of pasta alone or in the context of low-GI dietary patterns on measures of
24
25 **39** global (body weight, BMI, body fat) and regional (waist circumference, waist-to-hip ratio,
26
27 **40** sagittal abdominal diameter) adiposity in adults.

28
29 **41 Data extraction and synthesis:** Two independent reviewers extracted data and assessed risk of
30
31 **42** bias. Data were pooled using the generic inverse-variance method and expressed as mean
32
33 **43** differences (MDs) with 95% confidence intervals (95% CIs). Heterogeneity was assessed
34
35 **44** (Cochran Q statistic) and quantified (I^2 -statistic). GRADE assessed the certainty of the evidence.
36
37

38
39 **45 Results:** We identified no trials of the effect of pasta alone and 32 trial comparisons (n=2,448
40
41 **46** participants) of the effect of pasta in the context of low-GI dietary patterns. Pasta in the context
42
43 **47** of low-GI dietary patterns significantly reduced body weight (MD=-0.63kg [95% CIs,-0.84,-
44
45 **48** 0.42kg]) and BMI (MD=-0.26kg/m² [95% CIs,-0.36,-0.16kg/m²]) compared with higher-GI
46
47 **49** dietary patterns. There was no effect on other measures of adiposity. The certainty of the
48
49 **50** evidence was graded as moderate for body weight, BMI, WHR, and SAD and low for WC and
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51 **51** body fat.

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2
3 52 **Conclusions:** Pasta in the context of low-GI dietary patterns does not adversely affect adiposity
4
5 53 and even reduces body weight and BMI compared to higher GI dietary patterns. Future trials
6
7 54 should assess the effect of pasta in the context of other healthy dietary patterns.
8
9

10 55 **Protocol registration:** ClinicalTrials.gov Identifier, NCT02961088
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12 56
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16

17 58 **Strengths and limitations of this study**

- 19 59 - The present systematic review and meta-analysis was based on a comprehensive search
20
21 60 and includes a large number of randomized controlled trials which provide the best
22
23 61 protection against bias.
24
25
26 62 - We used the Grading of Recommendations Assessment, Development, and Evaluation
27
28 63 (GRADE) approach to evaluate the strength and quality of the evidence.
29
30
31 64 - There was evidence of unexplained inconsistency in the intervention estimates across
32
33 65 trials for waist circumference and body fat.
34
35 66 - The generalizability of our results is questionable with evidence of indirectness in the
36
37 67 pooled estimates for all body and adiposity outcomes, as all of the trials assessed pasta in
38
39 68 the context of low-GI dietary patterns (no trials assessed the effect of pasta alone or in the
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41 69 context of other dietary patterns) and most of the available trials did not quantify the
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44 70 amount of pasta consumed.
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71 INTRODUCTION

72 As the role of saturated fat in chronic disease has been called into question, carbohydrates have
73 come under attack in the media^{1,2}, popular books³⁻⁹, statements of health advocacy groups¹⁰ and
74 commentaries in leading medical journals^{11,12}. Much of the attention has focused on sugars but
75 traditional carbohydrate staples like pasta, rice, and breads are increasingly being implicated in
76 the epidemics of overweight and obesity^{1,7}. Although systematic reviews and meta-analyses of
77 randomized controlled trials of dietary patterns that are high in these foods but low in glycemic
78 index (GI)^{13,14}, high in whole grains^{15,16}, and/or high in dietary fibre have shown advantages for
79 weight related outcomes^{17,18}, there has been a general lack of recognition of the importance of
80 carbohydrate quality.

81 Pasta is an important example of a food which is considered a refined carbohydrate but has a
82 low-GI, a property that has been exploited extensively in studies of low-GI dietary patterns. It
83 remains unclear whether pasta alone or in the context of a low-GI dietary pattern shares the
84 advantages of other low-GI foods or on the contrary contributes to weight gain. We are not
85 aware of any systematic reviews and meta-analyses which have synthesized the evidence of the
86 effect of pasta on body weight outcomes. We undertook a systematic review and meta-analysis
87 of randomized controlled trials (RCTs) using the GRADE approach to quantify the effect of
88 pasta alone or in the context of low-GI dietary patterns on body weight and measures of
89 adiposity relevant to the prevention and management of overweight and obesity.

90

91 METHODS

92 Design

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3 93 Our protocol followed the guideline of the Cochrane Handbook for Systematic Reviews of
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5 94 Interventions¹⁹, and findings are reported according to the guidelines of the Preferred Reporting
6
7 95 Items for Systematic Reviews and Meta-Analyses²⁰ (**Supplemental Table S1**). The protocol is
8
9 96 registered at clinicaltrials.gov (identifier, NCT02961088).
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14 98 **Data sources and searches**

15
16 99 We searched MEDLINE (<http://www.nlm.nih.gov/bsd/pmresources.html>), Embase
17
18
19 100 (<https://www.embase.com>), CINAHL (<https://health.ebsco.com/products/the-cinahl-database>),
20
21 101 and the Cochrane Library (<http://www.cochranelibrary.com/>) from inception through 07
22
23 102 February 2017. The full search terms used in this study are presented in **Supplemental Tables**
24
25 103 **S2-S3**. Briefly, we searched using variations of the terms pasta and glycemic index and glycemic
26
27 104 load and body weight and BMI. The search was limited to human studies and had no language
28
29 105 restrictions. Reference lists of selected studies and reviews were also searched to identify
30
31 106 additional articles.
32
33
34

35 107 36 37 108 **Study selection**

38
39 109 We include RCTs that investigated the effect of pasta consumed alone or in the context of low-
40
41 110 GI dietary patterns that emphasized pasta in comparison with higher GI diets that did not include
42
43 111 pasta on body weight or other measures of global (BMI, body fat) or abdominal (waist
44
45 112 circumference, waist-to-hip ratio, sagittal abdominal diameter, or visceral adipose tissue assessed
46
47 113 by imaging modalities) adiposity in participants of all health backgrounds. Trials were included
48
49 114 if the intervention arm assessed the effect of pasta consumed alone or assessed the effect of a low
50
51 115 GI diet which emphasized pasta as part of the low GI dietary advice. Trials were excluded if they
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3 116 had diet duration of <3 weeks, did not intend to use a calorie- and macronutrient-matched
4
5 117 comparator arm that was higher in GI; included pregnant or breast-feeding women or children; or
6
7
8 118 did not provide suitable end-point data. When multiple publications existed for the same study,
9
10 119 the article with the most information was included (n=6). Published abstracts were not included.
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12
13

14 121 **Data extraction**

16
17 122 Two reviewers (LC, CB) assessed the titles and abstracts of all identified studies and
18
19 123 independently reviewed and extracted relevant data from each report, including study design,
20
21 124 blinding, sample size, participant characteristics, follow-up duration, identification of pasta in the
22
23 125 low-GI diet only, comparator diet, macronutrient profile, funding source, and outcome data. The
24
25 126 primary outcome was body weight, and secondary outcomes included markers of global (BMI,
26
27 127 body fat) and abdominal (waist circumference, waist-to-hip ratio, sagittal abdominal diameter, or
28
29 128 visceral adipose tissue assessed by imaging modalities) adiposity. Mean±SD differences between
30
31 129 test and control arms were extracted for each outcome.
32
33

34
35 130 In those trials where the data were included in figures and not provided numerically, we used the
36
37 131 software program Plot Digitizer version 2.6.8 (<http://plotdigitizer.sourceforge.net/>) to extract the
38
39 132 data. This program is a JAVA program that digitizes scanned figures of X and Y plots from GIF,
40
41 133 JPEG, or PNG image file formats and allows one to calibrate the X and Y axes for the estimation
42
43 134 data points. Additional information was requested from the authors of all included trials.
44
45

46
47 135 Disagreement were resolved by consensus or where necessary by a third author (SBM).
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49

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51 137 **Risk of bias assessment**

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3 138 Risk of bias for each individual study was assessed using the Cochrane Risk of Bias tool¹⁹. The
4
5 139 level of bias was evaluated for sequence generation, allocation concealment, blinding,
6
7
8 140 incomplete outcome data, and selective reporting and determined overall as either low (proper
9
10 141 methods taken to reduce bias), high (improper methods creating bias), or unclear (insufficient
11
12 142 information provided to determine the bias level).
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15 143

16 17 144 **Statistical analysis**

18
19 145 Baseline, end-of-study, and between-treatment differences in body weight, BMI, waist
20
21 146 circumference, body fat, waist-to-hip ratio, sagittal abdominal diameter or visceral adipose tissue
22
23
24 147 assessed by imaging modalities were recorded as means±SDs. If not provided, between-
25
26 148 treatment differences in change-from-baseline or end differences were calculated by subtracting
27
28 149 means and variance measures such as SEs were imputed with the use of published formulas¹⁹.
29
30
31 150 Missing SDs were imputed with the use of the pooled SD from other studies included in the
32
33 151 analysis¹⁹.
34
35 152 Data analyses were conducted using Review Manager (RevMan) version 5.3 (Copenhagen,
36
37
38 153 Denmark: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) for primary
39
40 154 analyses and Stata version 13 (College Station, TX: StataCorp LP) for subgroup analyses. A
41
42 155 generic inverse-variance method with random-effects models was used to calculate pooled mean
43
44
45 156 differences and 95% confidence intervals (CIs). Random-effects models were used even in the
46
47 157 absence of statistically significant inter-study heterogeneity, as they yield more conservative
48
49 158 summary effect estimates in the presence of residual heterogeneity. Change-from-baseline
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51 159 differences were preferred over end differences and paired analyses were applied to all crossover
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3 160 trials with the use of a within-individual correlation coefficient between treatments of 0.5 as
4
5 161 described by Elbourne et al.²¹
6
7 162 Inter-study heterogeneity was assessed by the Cochran Q statistic, where $P < 0.10$ was considered
8
9 163 statistically significant, and quantified by the I^2 statistic, where $I^2 \geq 50\%$ indicates substantial
10
11 164 heterogeneity¹⁹. Sensitivity analysis were performed which included the removal of each single
12
13 165 study from the meta-analyses one at a time and recalculation of the summary effect. An
14
15 166 influential study was considered a study whose removal changed the magnitude of the pooled
16
17 167 effect by $>10\%$. Sensitivity analysis were also conducted using different correlation coefficient
18
19 168 values for crossover trials (0.25 and 0.75) to test for the robustness of the effect size, conducting
20
21 169 analyses using fixed effects models and restricting analyses to those trials for which pasta intake
22
23 170 could be quantified.
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27
28 171 If ≥ 10 trial comparisons were available, then sources of heterogeneity were explored by
29
30 172 subgroup analyses. A priori categorical subgroups analyses were assessed by meta-regression
31
32 173 analyses. These included patient type (normal body weight, overweight or obese [average
33
34 174 baseline BMI $>27\text{kg/m}^2$]), diabetes, coronary heart disease), follow-up (<24 -weeks, ≥ 24 weeks),
35
36 175 baseline BMI (BMI ≤ 30 , $>30\text{kg/m}^2$), design (parallel, crossover), energy balance (negative on
37
38 176 both arms [weight loss diets], neutral on both arms [weight maintaining diets]) and dose of pasta
39
40 177 (based on the median). A priori categorical subgroup analyses also included the following dietary
41
42 178 factors: GI (absolute level [≤ 55 , >55 ; glucose scale], within-treatment change, between-treatment
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44 179 change), fat intake (absolute level [$<30\%$, $\geq 30\%$ energy], within-treatment change, between-
45
46 180 treatment change), carbohydrate intake (absolute level [$<50\%$, $\geq 50\%$ energy], within-treatment
47
48 181 change, between-treatment change), protein intake (absolute level [$<20\%$, $\geq 20\%$ energy], within-
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50 182 treatment change, between-treatment change), dietary fibre intake (absolute level [$<28\text{g/day}$,
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3 183 ≥ 28 g/day], within-treatment change, between-treatment change), and risk of bias. A priori
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5 184 continuous meta-regression analyses were conducted on the absolute levels and within- and
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7
8 185 between-treatment changes of these same dietary factors in the intervention arms of pasta in the
9
10 186 context of low-GI dietary patterns. Linear and non-linear pasta intake dose-response analyses
11
12 187 were assessed by using continuous meta-regression analyses and spline curve modeling
13
14 188 (MKSPLINE procedure), respectively. Publication bias was assessed by visual inspection of
15
16 189 funnel plots and the Egger²² and Begg²³ tests, when ≥ 10 trial comparisons were available. If
17
18 190 publication bias was suspected, then adjustment for funnel plot asymmetry was done by imputing
19
20 191 missing study data using the Duval and Tweedie trim and fill method²⁴.
21
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26 193 **Grading the evidence**

27
28 194 The grading of recommendations assessment, development, and evaluation (GRADE) approach
29
30 195 was used to assess the certainty of the evidence²⁵. Evidence was graded as high, moderate, low
31
32 196 or very low quality. The included RCTs were graded as high quality evidence by default and
33
34 197 downgraded based on pre-specified criteria. Criteria to downgrade evidence included risk of bias
35
36 198 (weight of studies show risk of bias assessed by the Cochrane Risk of Bias tool), inconsistency
37
38 199 (substantial unexplained heterogeneity, $I^2 > 50\%$, $P < 0.10$), indirectness (presence of factors that
39
40 200 limited the generalizability of the results), imprecision (the 95% CI for effect estimates were
41
42 201 wide or crossed pre-specified minimally important differences [MIDs] for harm), and publication
43
44 202 bias (significant evidence of small-study effects).
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52 204 **Patient involvement**

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3 205 No patients were directly involved in the development of the research question, selection of the
4
5 206 outcome measures, design and implementation of the study, or interpretation of the results.
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9 10 208 **RESULTS**

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12 209

13 14 210 **Search results**

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16
17 211 **Figure 1** shows the flow of the literature. We identified 4876 reports of which 29 met eligibility
18
19 212 criteria. No reports were identified that assessed the effect of pasta alone, while 29 reports
20
21 213 (including 32 trial comparisons involving 2448 participants) were identified that assessed the
22
23 214 effect of pasta in the context of low-GI dietary patterns on any adiposity outcome in adults²⁶⁻⁵⁴.
24
25 215 Of the 32 trial comparisons that assessed the effect of pasta in the context of a low-GI dietary
26
27 216 pattern, there were 32 trial comparisons for body weight, 18 trial comparisons for BMI<sup>27,28,31-
28
29 33,35,36,39-41,43-46,48,49,52,53</sup>, 18 trial comparisons for waist circumference^{27,28,31,33,34,36,38-40,42,44-47,52,53},
30
31 217 10 trial comparisons for body fat^{27,28,31-33,36,38,41,43,53}, 6 trial comparisons for waist-to-hip
32
33 218 ratio^{31,39,40,44,45,52}, and 3 trial comparisons for sagittal abdominal diameter^{34,39}. There was only
34
35 219 one trial comparison identified³⁵ for visceral adipose tissue assessed by imaging modalities, thus
36
37 220 a meta-analysis could not be undertaken for this outcome.
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39 221
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43 44 223 **Trial characteristics**

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46
47 224 **Table 1** and **Supplemental Table S4** show the characteristics of all included trials of the effect
48
49 225 of pasta in the context of low-GI dietary patterns. The majority of trials had a parallel design
50
51 226 (26/32) with a median follow-up of 12 weeks (IQR: 9–21 weeks) and a median number of
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53 227 participants per trial of 43 (IQR: 21–112). Most participants were middle aged (median age: 50
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3 228 y; IQR: 40-58 y) men and women (median ratio of men to women: 0.4:1 in available trials). The
4
5 229 median baseline BMI across studies was 30.4kg/m² (IQR: 28.2–32.0). Regarding metabolic
6
7 230 phenotype, 21 (66%) trials included participants who were overweight or obese (had a baseline
8
9 231 BMI≥27kg/m²), 10 (31%) had diabetes and one trial (3%) with coronary heart disease (CHD).
10
11 232 We did not retrieve any trials where participants had a normal BMI at baseline (≤25kg/m²),
12
13 233 although 6 trials did not include BMI >25 kg/m² as part of criteria, the average baseline BMI was
14
15 234 ≥27 kg/m², therefore categorized as overweight.
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235

236 **Risk of bias**

237 **Supplemental Figures S1 and S2** show the individual Cochrane Risk of Bias tool assessments
238 for each of the included trials of the effect of pasta in the context of low-GI dietary patterns. No
239 serious risk of bias was detected.
240

241

241 **Effect of Pasta in the Context of Low-GI dietary patterns and Body Weight**

242 **Figure 2** shows the effect of pasta in the context of low-GI dietary patterns on the primary
243 outcome body weight. Pooled analyses showed pasta in the context of low-GI dietary patterns
244 had the effect of reducing body weight by -0.63 kg (95% CI:-0.84, -0.42 kg; P<0.001) compared
245 with higher GI control diets with no evidence of heterogeneity (I²=0%, P-heterogeneity=0.51).
246

247

247 **Effect of Pasta in the Context of Low-GI dietary patterns on Markers of Global Adiposity**

248 **Figure 3 and Supplemental Figure S3-S4** show the effect of pasta in the context of low-GI
249 dietary patterns on markers of global adiposity. Pooled analyses showed that pasta in the context
250 of low-GI dietary patterns had the effect of reducing BMI by -0.26kg/m² (n=18 trials; MD=-

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2
3 251 0.26kg/m²; 95% CI:-0.36, -0.16 kg/m²; P<0.001) compared with higher GI control diets with no
4
5 252 evidence of heterogeneity (I²=0%, P-heterogeneity=0.90). There was no effect on body fat (n=10
6
7 253 trials; MD=-0.01%, 95% CI:-0.58, 0.56%; P=0.98) with evidence of substantial heterogeneity
8
9 254 (I²=65%, P-heterogeneity<0.01).
10
11
12
13

14 256 **Effect of Pasta in the Context of Low-GI dietary patterns on Markers of Abdominal** 15 16 17 257 **Adiposity**

18
19 258 **Figure 3 and Supplemental Figures S5-S7** show the pooled estimates for the markers of
20
21 259 abdominal adiposity. Pooled analyses did not show a significant effect of pasta in the context of
22
23 260 low-GI dietary patterns compared with higher-GI control diets on waist circumference (n=18
24
25 261 trials; MD=-0.46cm, 95% CI:-1.05, 0.14cm; P=0.13), waist-to-hip ratio (n=6 trials; MD=-0.00,
26
27 262 95% CI:-0.01, 0.00; P=0.27), or sagittal abdominal diameter (n=3 trials, MD=-0.09cm, 95% CI:-
28
29 263 0.34, 0.16cm; P=0.48) There was only evidence of substantial heterogeneity in the analyses for
30
31 264 waist circumference (I²=62%, P-heterogeneity<0.01).
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38 266 **Sensitivity analyses**

39
40 267 We conducted four sets of sensitivity analyses (**Supplemental Tables S5-6, Supplemental**
41
42 268 **Figures S8-9**). The systematic removal of each trial did not modify the direction or significance
43
44 269 of the effect estimates or the evidence of heterogeneity for any of the outcomes with the
45
46 270 exception of waist circumference (**Supplemental Table S5**). In the sensitivity analysis for waist
47
48 271 circumference, two studies were influential studies in that their removal altered the magnitude of
49
50 272 the pooled effect in the remaining studies by >10%, where the removal of the studies of
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52 273 McMillan-Price et al. (high protein comparison)⁴² and Jenkins et al.⁴⁴ rendered the results for
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3 274 waist circumference statistically significant (MD= -0.62cm; 95% CI: -1.19, -0.05; P=0.03) and
4
5 275 (MD= -0.61cm; 95% CI: -1.18, -0.04; P=0.04), respectively; forest plots not shown).
6
7 276 Heterogeneity remained significant in both cases ($I^2= 55%$, P-heterogeneity<0.01 and $I^2=50%$, P-
8
9 277 heterogeneity=0.01, respectively). Sensitivity analyses using correlation coefficients of 0.25 and
10
11 278 0.75 for paired analyses of crossover trials also did not modify the results (**Supplemental Table**
12
13 279 **S6**). In the sensitivity analyses where fixed effects models were applied (**Supplemental Figure**
14
15 280 **S8**), the direction, magnitude and significance of the pooled estimates were very similar to those
16
17 281 produced by the random effects models with the exception of the sensitivity analysis for waist
18
19 282 circumference which was significant (MD= -0.62; 95% CI: -0.93, -0.32; P<0.001). Finally,
20
21 283 restricting analyses to the 11 trials for which pasta intake could be quantified (median pasta
22
23 284 intake, 3.33 servings/week [range, 1.75 – 7 servings/week]) showed a similar reduction in body
24
25 285 weight (MD= -0.70 kg; 95% CI:-1.10, -0.29 kg; P<0.001) when pasta was consumed in the
26
27 286 context of low-GI dietary patterns compared with the higher GI control arms without evidence of
28
29 287 heterogeneity ($I^2=0%$, P-heterogeneity=0.68) (**Supplemental Figure S9**).
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288 289 **Subgroup analyses**

38 290 We were only able to conduct a priori categorical and continuous subgroup analyses for body
39
40 291 weight, BMI, body fat and waist circumference. Subgroup analyses for waist-to-hip ratio and
41
42 292 sagittal abdominal diameter could not be assessed, owing to <10 trial comparisons in each case.
43
44 293 **Supplemental Figures S10-S12** show the categorical a priori subgroup analyses for body
45
46 294 weight. There was no evidence of significant effect modification in any of the subgroup analyses
47
48 295 for body weight, including no effect modification of follow-up when comparing studies less than
49
50 296 24 weeks duration to those greater than or equal to 24 weeks (-0.63kg vs -0.57kg, respectively)
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3 297 **(Supplemental Figure S10)**. Neither was there evidence of significant effect modification in any
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5 298 of the subgroup analyses for BMI, body fat or waist circumference **(Supplemental Figures S13-**
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7 299 **20)**.
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11
12 301 **Supplemental Table S7** and **Supplemental Figures S21-22** show the continuous subgroup
13
14 302 analyses for body weight. There was evidence of significant effect modification by carbohydrate
15 303 and protein intake, where an increase in carbohydrate intake in the intervention group in which
16 304 pasta was consumed in the context of low-GI dietary patterns was associated with weight loss
17 305 ($\beta = -0.07$, 95% CI: -0.12, -0.01, $I^2 = 0.00\%$, $P = 0.02$), and an increase in protein intake in the
18 306 intervention group in which pasta was consumed in the context of low-GI dietary patterns was
19 307 associated with weight gain ($\beta = 0.15$, 95% CI: 0.03, 0.27, $I^2 = 0.00\%$, $P = 0.02$). None of the other
20 308 continuous subgroup analyses were significant. There was no evidence of significant effect
21 309 modification in any of the continuous subgroup analyses for BMI **(Supplemental Table S8)**. For
22 310 body fat, there was evidence of significant effect modification in the continuous meta-regression
23 311 subgroup analysis of difference in GI between intervention and control groups, where greater
24 312 difference in GI between the groups was associated with greater reduction in body fat in the
25 313 intervention group ($\beta = -0.09$, 95% CI: -0.15, -0.03, $I^2 = 19.39\%$, $P = 0.01$) **(Supplemental Table**
26 314 **S9)**. None of the other continuous subgroup analyses were significant. For waist circumference,
27 315 there was evidence of significant effect modification in the continuous meta-regression subgroup
28 316 analysis of absolute carbohydrate level and absolute protein level, where greater carbohydrate
29 317 level in the intervention group in which pasta was consumed in the context of low-GI dietary
30 318 patterns was associated with greater loss in waist circumference ($\beta = -0.11$, 95% CI: -0.19, -0.04,
31 319 $I^2 = 27.06\%$, $P < 0.01$) and a lower protein level in the intervention group in which pasta was
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3 320 consumed in the context of low-GI dietary patterns was associated with an increase in waist
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5 321 circumference ($\beta= 0.20$, 95% CI: 0.01, 0.38, $I^2=43.92\%$, $P=0.04$) (**Supplemental Table S10**).
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7
8 322 None of the other continuous subgroup analyses were significant.
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11 324 **Dose-response analyses**

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14 325 **Supplemental Tables S7 and S11** and **Supplemental Figure S23** show the dose-response
15
16 326 analysis for the 11 trials for which pasta intake could be quantified. No evidence of a linear dose
17
18 327 response was seen for pasta intake by meta-regression analyses (**Supplemental Table S7**).
19
20 328 There was also no evidence of a non-linear dose response by MKSPLINE ($P=0.85$)
21
22 329 (**Supplemental Figure S23**) or piecewise linear meta-regression analyses (**Supplemental Table**
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24 330 **S11**).
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27 332 **Publication Bias**

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29 333 **Supplemental Figures S24-S27** shows the funnel plots for body weight, BMI, body fat and
30
31 334 waist circumference. There was no evidence of funnel-plot asymmetry. Formal testing with the
32
33 335 Egger and Begg tests did not show evidence of small-study effects ($P>0.05$ for both). Publication
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35 336 bias was not assessed for waist-to-hip ratio and sagittal abdominal diameter, owing to <10 trial
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37 337 comparisons.
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40 339 **GRADE Assessment**

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42 340 **Supplemental Table S12** shows a summary of the GRADE assessments for the effect of pasta in
43
44 341 the context of low-GI dietary patterns on body weight and measures of adiposity. The evidence
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46 342 was graded as moderate for body weight, BMI, waist-to-hip ratio and sagittal abdominal
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3 343 diameter owing to downgrades for indirectness and low for waist circumference and body fat,
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5 344 owing to downgrades for indirectness and inconsistency ($I^2=59%$, P -heterogeneity <0.001 ;
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7 345 $I^2=66%$, P -heterogeneity <0.01 , respectively).
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11 347 **DISCUSSION**

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14 348 The present systematic review and meta-analysis quantified the effect of pasta alone and pasta in
15
16 349 the context of low-GI dietary patterns on body weight and other markers of adiposity. We failed
17
18 350 to identify any trial comparisons for the effect of pasta alone but did identify 32 trial comparisons
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20 351 for the effect of pasta in the context of low-GI dietary patterns in 2448 participants who were
21
22 352 predominantly middle-aged and overweight or obese. The primary pooled analysis demonstrated
23
24 353 that pasta in the context of low-GI dietary patterns did not contribute to weight gain, resulting in
25
26 354 a significant weight loss of -0.63kg when compared to diets higher in GI over a median follow-
27
28 355 up of 12 weeks. The lack of harm was reflected in the established clinical secondary outcome
29
30 356 measures of global (BMI and body fat) and abdominal adiposity (waist circumference, waist-to-
31
32 357 hip ratio and sagittal abdominal diameter). These findings were robust across subgroups. The
33
34 358 findings did not differ by metabolic phenotype in those who were overweight or obese or had
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36 359 diabetes, which is noteworthy since these are populations who would benefit from weight
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38 360 management strategies. There was also no effect modification by the energy balance of the
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40 361 design such that the weight loss was seen even under conditions of neutral energy balance (in
41
42 362 which participants were instructed to consume dietary advice ad libitum), suggesting that
43
44 363 encouragement of the consumption of pasta in the context of a low-GI dietary patterns does not
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46 364 cause harm and may even lead to spontaneous weight loss. There was also no effect modification
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48 365 by follow-up either in continuous meta-regression or categorical, where the 24 trials with
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3 366 <24weeks follow-up had a weight reduction similar to those 8 trials with ≥ 24 weeks follow-up (-
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5 367 0.63kg vs -0.57kg, respectively). This is of relevance since many dietary studies are successful in
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8 368 demonstrating weight loss in the short term but not over the long term.
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11 12 370 **Findings in the context of existing studies**

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14 371 We are not aware of any RCTs directly assessing the effect of pasta intake on any health
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16 372 parameters including body weight. Our findings, however, agree with earlier systematic reviews
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18 373 and meta-analyses of RCTs of the effect of low-GI dietary patterns irrespective of pasta intake
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20 374 on body weight and adiposity. The systematic review and meta-analysis by Thomas et al. in 2007
21
22 375 found a significant -1.1kg weight loss and $-1.3\text{kg}/\text{m}^2$ reduction in BMI favouring low-GI or
23
24 376 glycemic load (GL) diets compared to control diets in 6 RCTs of 5 weeks to 6 months in duration
25
26 377 in overweight or obese individuals¹³. Another systematic review and meta-analysis by
27
28 378 Schwingshackl et al. in 2013 found a -0.62kg weight loss favouring low-GI/GL diets compared
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30 379 to higher GI/GL diets in 14 RCTs with greater than 6 months duration in overweight individuals
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32 380 ($\text{BMI} > 25\text{kg}/\text{m}^2$)¹⁴.
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40 382 Our findings also agree with trials in which pasta was emphasized in the context of other healthy
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42 383 dietary patterns. One trial done in children in Spain given Mediterranean dietary advice which
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44 384 included increasing the intake of pasta found that approximately 11.3% of the participants in the
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46 385 Mediterranean diet group who were classified as overweight and obese changed their weight
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48 386 status to normal weight compared to only approximately 2.6% of the participants in the control
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50 387 group⁵⁵.
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3 389 Other lines of evidence from observational studies have demonstrated benefits of pasta
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5 390 consumption on body weight and adiposity. Pasta intake was recently assessed in the Moli-sani
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7 391 study and the Italian Nutrition & HEalth Survey (INHES), a cross-sectional study of over
8
9 392 20,000 Italians from all over Italy⁵⁶. The study demonstrated that higher pasta consumption was
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11 393 associated with lower BMI, waist circumference and waist-to-hip ratio and with a lower
12
13 394 prevalence of overweight and obesity⁵⁶. Furthermore, greater pasta intake was associated with
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15 395 better adherence to the Mediterranean diet, a dietary pattern which has a demonstrated
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17 396 cardiovascular benefit⁵⁷. Similar associations between greater pasta intake and lower body
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19 397 weight have also been observed in prospective U.S. cohorts⁵⁸. A pooled analysis of the 3
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21 398 Harvard cohorts also showed that higher GI diets (which would preclude pasta) were associated
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23 399 with weight gain⁵⁹.

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31 401 Although the product form of pasta can vary widely, including in shape (e.g. macaroni, spaghetti,
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33 402 linguine), ingredients (e.g. type of wheat, egg content), and processing technique (e.g. drying
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35 403 temperature), studies have demonstrated that when comparing pastas varying in these
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37 404 parameters, despite slight variations in glycemic response among pastas, glycemic responses are
38
39 405 still lower compared to a control, e.g. white bread^{60,61}. One concern of the choice of pasta as a
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41 406 carbohydrate food is that it is a refined food low in fibre. Although there are whole grain pasta
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43 407 options available, studies have demonstrated that fiber added to pasta, does not significantly
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45 408 affect the glucose or insulin response, the secretion of gut hormones or satiety^{62,63}. Furthermore,
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47 409 pasta has a similar glycemic response compared to many fiber-rich carbohydrates, including
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49 410 barley, legumes and steel cut oats, and still a lower glycemic response compared to other fiber-
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51 411 rich foods including whole wheat bread, breakfast cereals like bran flakes and potatoes with
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3 412 skin⁶⁴. The typically consumed white wheat pasta also has a higher micronutrient content
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5 413 compared to other white wheat products like bread since it contains the aleurone layer which is
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7 414 preserved as a result of the use of harder wheats (durum wheat); even when durum wheats are
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9 415 used in breads, pasta retains a lower glycemic response primarily because of the processing
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11 416 techniques used in pasta making which give pasta a compact structure and reduced starch
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14 417 hydrolysis⁶¹.

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19 419 The mechanism by which pasta in the context of low-GI dietary patterns lead to weight loss even
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21 420 under conditions of ad libitum dietary advice is unclear. Lower GI diets may result in greater
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23 421 body weight reduction compared to higher GI diets because lower GI foods may be more
24
25 422 satiating⁶⁵ and have been shown to delay hunger and decrease subsequent energy intake¹³. Low-
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27 423 GI dietary patterns are also characterized by high fiber content^{64,66} which may also contribute to
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29 424 improvements in satiety and hunger¹⁷. Furthermore, studies which have compared ad libitum
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31 425 low-GI dietary patterns to standard energy-restricted low-fat diets, demonstrated equivalency or
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33 426 better weight loss when following the low-GI diet, despite the fact that they could eat as much as
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35 427 they desired^{13,67}. Thus, voluntary energy intake may be lower after low-GI meals, as has been
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37 428 previously demonstrated⁶⁸.

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43 430 **Strengths and limitations**

44
45 431 The strengths of the present systematic review and meta-analysis include that it is
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47 432 comprehensive, includes RCTs which protects against bias and uses the GRADE approach to
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49 433 evaluate the quality of evidence. Additionally, a large number of trials were identified (32 trials)
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51 434 for the primary outcome of body weight, the median follow-up period was 12 weeks which
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3 435 allows for the assessment of a moderate duration of intervention, none of the trials were rated as
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5 436 having a serious risk of bias, and there was no evidence of publication bias.
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10 438 There are several limitations. First, we downgraded the certainty of the evidence for serious
11
12 439 inconsistency in the treatment estimates across trials for some of the outcomes assessed. There
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14 440 was evidence of unexplained heterogeneity in waist circumference ($I^2=62\%$) and in body fat
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16 441 ($I^2=65\%$). Although the inconsistency in these outcomes may have related to measurement
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18 442 error⁶⁹ in the different techniques for measuring waist circumference and body fat, we were
19
20 443 unable to conduct sensitivity or subgroup analyses to explore this source of heterogeneity.
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22 444 Second, we downgraded the certainty of the evidence for serious indirectness. Most of the
23
24 445 available trials did not quantify the amount of pasta consumed in the context of the low-GI
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26 446 dietary patterns. Although sensitivity analyses in which analyses were restricted to the 11 trials
27
28 447 that did quantify (providing a median 3.33 servings/week) pasta intake did not meaningfully alter
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30 448 our estimates (-0.70kg versus -0.63kg), it is difficult to quantify the effect of pasta in these diets.
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32 449 There is also the question of indirectness in the translation to other background diets. None of the
33
34 450 available trials evaluated the effect of pasta alone or in the context of other dietary patterns.
35
36 451 Whether the observed effect of pasta in the context of low-GI dietary patterns will hold in the
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38 452 context of other healthy dietary patterns, such as Mediterranean and Vegetarian dietary patterns,
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40 453 is unclear. Although there is no biological reason to doubt that the findings would hold across
41
42 454 different dietary patterns, there was no direct evidence to support this conclusion. If the question
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44 455 had been asked from the perspective of benefit as opposed to that of harm, then the relatively
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46 456 short duration of the included trials is another reason to downgrade for serious indirectness. In
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48 457 the absence of long-term trials (>1 year diet duration), it is difficult to conclude with certainty
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3 458 that the observed lack of harm implies an actual sustainable benefit. Finally, there was some
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5 459 evidence of imprecision for benefit. Whereas the 95% CI of the pooled estimates did not overlap
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7 460 with our pre-specified MID for harm (that is, they did not contain evidence for harm) and so
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9 461 were not downgraded for imprecision, the upper bound of the 95% CI did overlap with the lower
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11 462 bound of the same MID to assess the precision of the evidence for benefit for some outcomes.
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17 464 Balancing these strengths and limitations, the GRADE approach assessed the overall quality and
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19 465 strength of the available evidence of the effect of pasta in the context of low-GI dietary patterns
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21 466 as moderate for the primary outcome of body weight and the secondary outcomes of BMI, waist-
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23 467 to-hip ratio and sagittal abdominal diameter owing to downgrades for indirectness. The evidence
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25 468 was assessed as low for the other secondary outcomes of body fat and waist circumference
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27 469 owing to downgrades for indirectness and inconsistency.
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32 33 471 **Implications**

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35 472 These results are important considering the negative messages directed at the public regarding
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37 473 carbohydrates, which is influencing their food choices, as is evident in recent reductions in
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39 474 carbohydrate intake⁷⁰⁻⁷², and in particular reductions in pasta consumption^{70,73-76}. Contrary to
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41 475 these concerns, the available evidence shows that when pasta is consumed in the context of low-
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43 476 GI dietary patterns that there is not weight gain but rather marginally clinically significant weight
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45 477 loss (>0.5kg)⁷⁷.
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51 479 Although we were able to approximate the amount of pasta consumed in one third of included
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53 480 trials, it is unclear what the effect of pasta would be in the context of other dietary patterns. Low-
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3 481 GI dietary patterns, however, shares many similarities with a Mediterranean diet, which
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5 482 emphasizes many low-GI foods and has demonstrated a CVD benefit⁵⁷.

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10 484 Current clinical practice guidelines already suggest the replacement of high GI foods with low-
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12 485 GI foods for improvement of glycemic control and cardiovascular risk factors^{78,79}. The present
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14 486 evidence means that pasta may be highlighted as an important example of a low-GI food which
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16 487 can contribute to a low-GI dietary pattern, a pattern which in turn may potentially improve
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19 488 cardio-metabolic risk without an adverse effect on weight control.
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23 24 490 **CONCLUSIONS**

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26 491 In conclusion, the available evidence from RCTs does not allow us to conclude that pasta
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28 492 consumed in the context of low-GI dietary patterns has an adverse effect on body weight and
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30 493 adiposity outcomes of importance in the prevention and management of overweight and obesity.

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32
33 494 On the contrary, pasta in the context of low-GI dietary patterns reduces body weight and BMI
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35 495 compared with higher-GI dietary patterns. The results are generalizable in the context of a high
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37 496 carbohydrate dietary pattern composed of low-GI foods with or without the intention of weight
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39 497 loss in middle-aged individuals who are overweight or obese or have diabetes. Although the
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41 498 clinical significance of the observed weight loss is debatable, this finding increases our
42
43 499 confidence that pasta in the context of low-GI dietary patterns does not result in weight gain.

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45 500 Further research may change our confidence in the estimates for our primary outcome body
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47 501 weight and several key secondary outcomes including BMI and two measures of abdominal
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49 502 adiposity, waist-to-hip ratio and sagittal abdominal diameter. More research is needed, to
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51 503 improve our estimates for the secondary outcomes, body fat and waist circumference and assess
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3 504 whether our findings extend to related cardio-metabolic outcomes. There is also a need for more
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5 505 randomized trials of >1 year diet duration to clarify whether the lack of harm for pasta in the
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7 506 context of low-GI dietary patterns will translate into meaningful long-term benefits. Other
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10 507 randomized trials should focus on whether pasta will have similar effects in the context of other
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12 508 healthy dietary patterns such as a Mediterranean diet.
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34 517 **Data Sharing**

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37 518 No additional data available.
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41 42 520 **Exclusive License**

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6 527 Not required.
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10

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12
13 530 and take full responsibility for the integrity of the data and the accuracy of the data analysis.
14
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52 544 honest, accurate, and transparent account of the study being reported; that no important aspects
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44
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31 601 Institute, Herbalife International, Pacific Health Laboratories, Nutritional Fundamental for
32 602 Health, Barilla, Metagenics, Bayer Consumer Care, Unilever Canada and Netherlands, Solae,
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35 605 Commission, Haine Celestial, PepsiCo, the Alpro Foundation, Pioneer Hi-Bred International,
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37 607 and Material Network, the Canola and Flax Councils of Canada, the Nutritional Fundamentals
38 608 for Health, Agri-Culture and Agri-Food Canada, the Canadian Agri-Food Policy Institute, Pulse
39 609 Canada, the Saskatchewan Pulse Growers, the Soy Foods Association of North America, the
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29 645 consulting arrangements with Winston & Strawn LLP, Perkins Coie LLP, and Tate & Lyle. He is
30 646 a member of the European Fruit Juice Association Scientific Expert Panel. He is on Clinical
31 647 Practice Guidelines Expert Committees of the Canadian Diabetes Association (CDA) European
32 648 Association for the study of Diabetes (EASD), and Canadian Cardiovascular Society (CCS), as
33 649 well as an expert writing panel of the American Society for Nutrition (ASN). He serves as an
34 650 unpaid scientific advisor for the Food, Nutrition, and Safety Program (FNSP) and the Technical
35 651 Committee on Carbohydrates of the International Life Science Institute (ILSI) North America.
36 652 He is a member of the International Carbohydrate Quality Consortium (ICQC), Executive Board
37 653 Member of the Diabetes and Nutrition Study Group (DNSG) of the EASD, and Director of the
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3 844 **Figure Legend**
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5 845 **Figure 1:** Literature Search
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7 846 **Figure 2:** Forest plot of randomized controlled trials investigating the effects of pasta in the
8 847 context of low-GI dietary patterns on body weight (kg). n = 2448. Data are expressed as mean
9 848 differences represented by a square and 95% CIs by the line through the square. 95% CIs
10 849 exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are
11 850 represented by diamonds and were estimated with the use of generic inverse variance random
12 851 effects models. Between-study heterogeneity was detected with the use of the Cochran's Q
13 852 statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where
14 853 $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable
15 854 heterogeneity.

16 855 CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic
17 856 index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty
18 857 acids; Pro, protein.
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23 859 **Figure 3:** Plot of pooled effect estimates from randomized controlled trials investigating the
24 860 effects of pasta in the context of low-GI dietary patterns on global and abdominal markers of
25 861 adiposity. Pooled effect estimates are represented by diamonds and were estimated with the use
26 862 of generic inverse variance random effects models. Between-study heterogeneity was detected
27 863 with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the
28 864 use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and
29 865 $\geq 75\%$ considerable heterogeneity.

30 866 BMI; body mass index; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic
31 867 index; LGI, low glycemic index diet.
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868 **Table 1:** Summary of trial characteristics

Trial Characteristics*	ALL	Neutral Energy Balance	Negative Energy Balance
Trial Number (n)	32	23	9
Trial Size (total, range)	2448 (8 - 250)	1989 (8 - 250)	459 (13 - 123)
Male: Female^a (%)	40:60	47:53	27:73
Age (years)	50 (40 - 58)	52.0 (42.1 – 59.5)	49.5 (34.2 – 53.0)
Metabolic Phenotype (OW/OB:DM:CHD) (%)	66:31:3	57:39:4	89:11:0
Setting (IP:OP) (%)	3:97	4:96	0:100
Baseline Body Weight (kg)^b	85.5 (80.0 - 91.9)	84.1 (79.5 – 87.5)	92.5 (86.1 – 93.9)
Baseline BMI (kg/m²)^c	30.4 (28.2 - 32.0)	29.5 (27.4 – 31.4)	31.7 (30.1 – 32.9)
Study Design (C:P) (%)	19:81	26:74	0:100
Dose Pasta (servings/week)^d	3.3 (2.3 - 3.5)	3.4 (2.9 – 4.1)	2.3 (2.3-3.5)
GI in Pasta/LGI group	49.0 (44.0 - 55.1)	46.5 (49.9 – 55.5)	44.0 (42.3 - 49.4)
GI in Higher GI group	62.5 (61.6 - 63.2)	63.3 (60.1 – 64.4)	61.0 (59.2 – 66.6)
Calorie reduction in Pasta/LGI group (kcal)^e	-179 (-90 - -448)	-165 (-74 - -313)	-447 (-134 - -594)
Calorie reduction in Higher GI group (kcal)^e	-181 (-93 - -401)	-160 (-40 - -248)	-470 (-172 - -561)
Feeding Control (Met:Supp:DA) (%)	6:44:50	4:48:48	11:33:56
Follow-Up Duration (Weeks)	12 (9-21)	12 (6-24)	12 (10 - 21)
Funding Sources (A:I:AI:NR) (%)	47:9:25:19	44:13:26:17	56:0:22:22

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870 * median (inter quartile range), unless otherwise indicated

871 ^a24/32 trials provided data on sex

872 ^b 30/32 trials reported baseline body weight

873 ^c 28/32 trials reported baseline BMI

874 ^d 11/32 trials provided data from which dose could be approximated

875 ^e 20/32 trials provided data from which to approximate changes in caloric intake

876 A, agency; AI, agency and industry; BMI, body mass index; C, crossover design; CHD, coronary
877 heart disease; DA, dietary advice; DM, diabetes; GI, glycemic index; I, industry; IP, inpatient;
878 LGI, low glycemic index; Met, metabolic; NR, not reported; OB, obese; OP, outpatient; OW,
879 overweight; P, parallel design; Suppl, supplemented/provision of certain food

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For peer review only

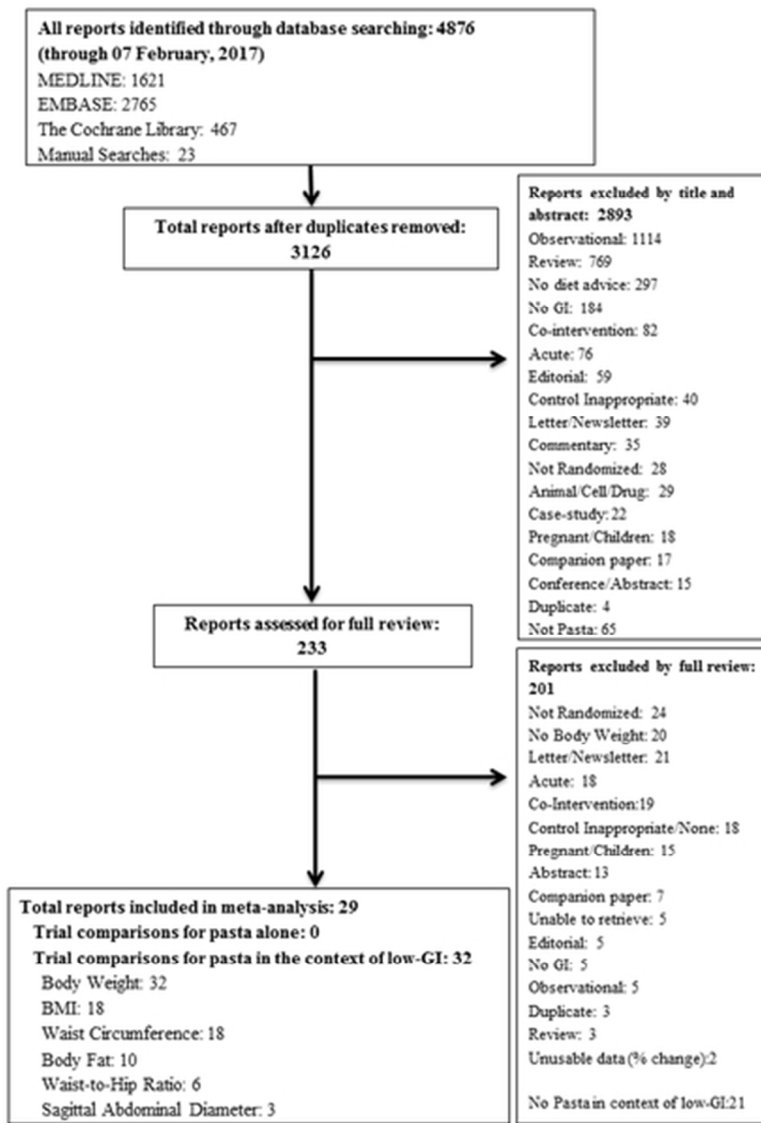


Figure 1: Literature Search

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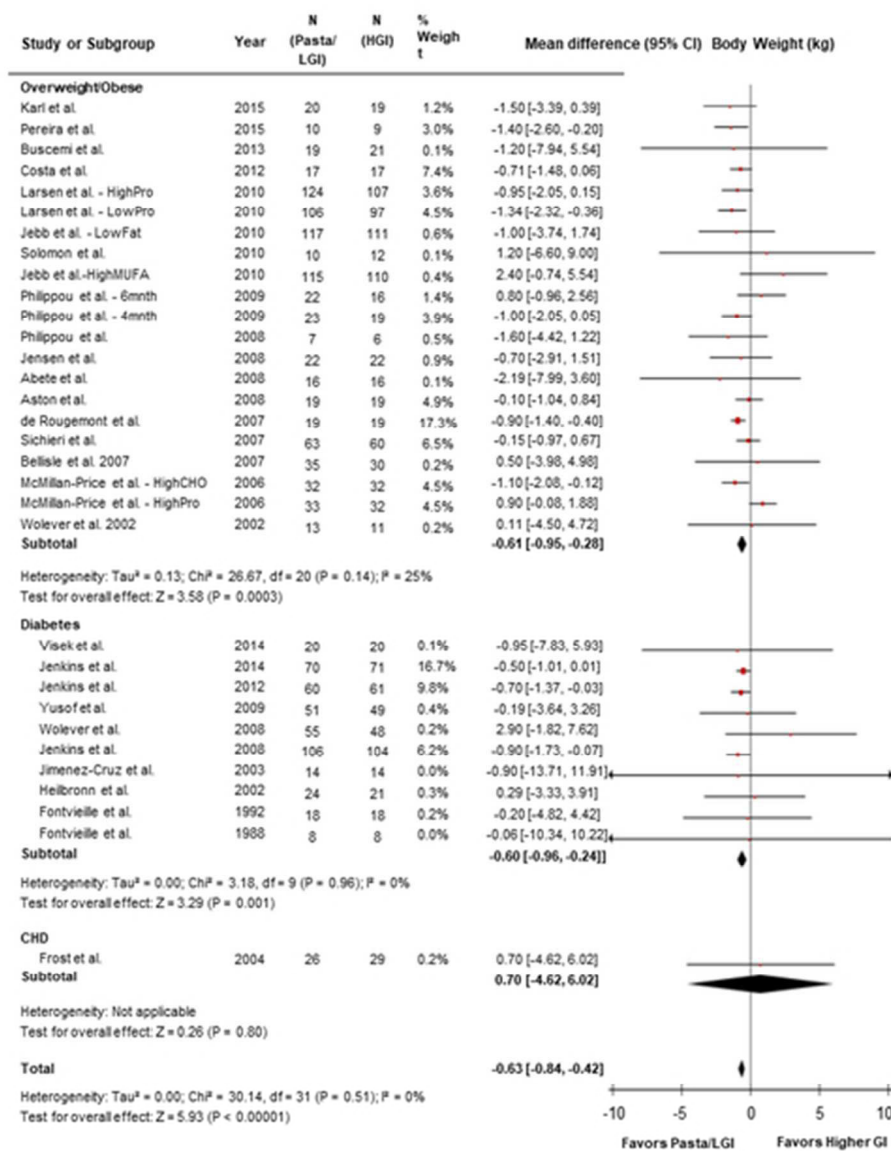


Figure 2: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg). n = 2448. Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids; Pro, protein.

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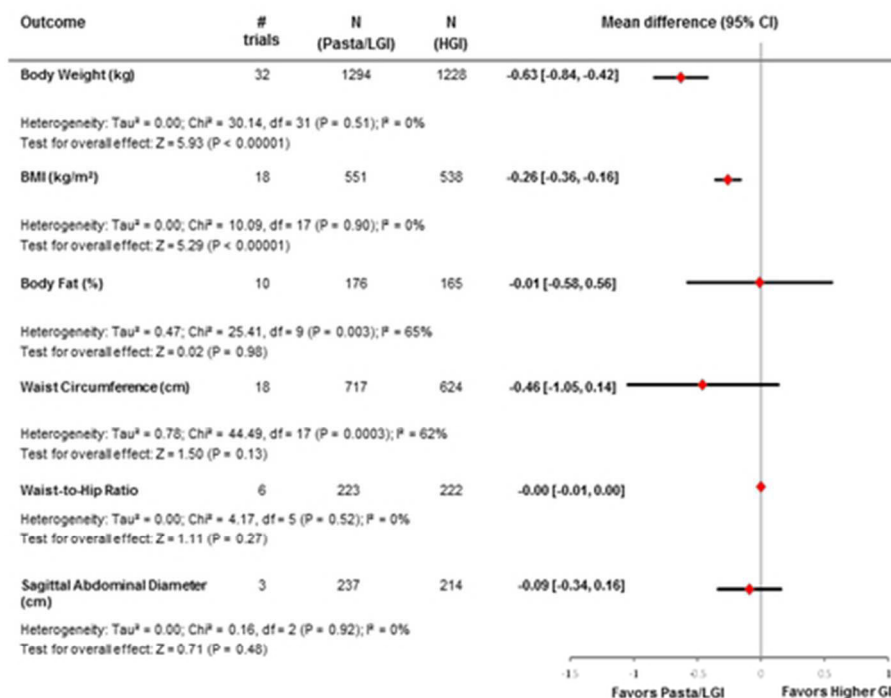


Figure 3: Plot of pooled effect estimates from randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on global and abdominal markers of adiposity. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran’s Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I² statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

BMI; body mass index; CI, confidence interval; HGI, higher glycemic index diet; LGI, low glycemic index diet.

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Online Supplemental Information

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Supplemental Tables

Supplemental Table S1: PRISMA Checklist



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-6, Supplemental Table S2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5, Supplemental Table S1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplemental Table S1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5-6, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6, Supplemental Table S2
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6-7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7-8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8
Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7-10
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	10, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-11, Table 1, Supplemental Tables S2-S3
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	11, Supplemental Figures S1-S2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11-13, Figures 2-3, Supplemental Figures S3-S7
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	11-13, Figures 2-3, Supplemental Figures S3-S7
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	11,15 Supplemental

			Table S1, S2, S12, S15, S17, S20
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	12-16, Supplemental Tables S4-S10, Supplemental Figures S8-S26
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16-22
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	19-21
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	22-23
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	26-31

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Supplemental Table S2: Search strategy for studies assessing the effect of pasta in the context of low-GI dietary patterns on body weight in randomized controlled trials

Database	Search Period	Search Terms
Medline	1946 to February 07, 2017	<ol style="list-style-type: none"> 1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycaemic index.tw. 8. glycemic index.tw. 9. glycaemic ind*.tw. 10. glycemic ind*.tw. 11. glycemic load*.tw. 12. glycaemic load*.tw. 13. glycemic index/ 14. body mass index/ 15. body mass index.tw. 16. BMI.tw. 17. overweight.tw. 18. weight*.tw. 19. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 20. 14 or 15 or 16 or 17 or 18 21. 19 and 20 22. limit 21 to animals 23. 21 not 22
Embase	1946 to February 07, 2017	<ol style="list-style-type: none"> 1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycaemic index.tw. 8. glycemic index.tw. 9. glycaemic ind*.tw. 10. glycemic ind*.tw. 11. glycemic load*.tw. 12. glycaemic load*.tw. 13. glycemic index/ 14. body mass index/ 15. body mass index.tw. 16. BMI.tw. 17. overweight.tw. 18. weight*.tw.

		<p>19. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 20. 14 or 15 or 16 or 17 or 18 21. 19 and 20 22. limit 21 to animals 23. 21 not 22</p>
The Cochrane Library	1946 to February 07, 2017	<p>1. pasta/ 2. spaghetti/ 3. macaroni/ 4. lasagna/ 5. fusilli/ 6. noodle/ 7. glycemic index/ 8. glycaemic ind*.tw. 9. glycemic ind*.tw. 10. glycemic load*.tw. 11. glycaemic load*.tw. 12. exp body weight/ 13. body weight*.tw. 14. BMI.tw. 15. body mass index/ 16. body mass index.tw. 17. weight*.tw. 18. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 19. 12 or 13 or 14 or 15 or 16 or 17 20. 18 and 19 21. limit 20 to animals 22. 20 not 21</p>

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Supplemental Table S3: PICO framework of the search strategy

PICO framework^a defined in the present systematic review and meta-analysis			
Participants	Interventions	Comparators	Outcomes
Adult men and women excluding pregnant or breastfeeding women	Low glyceic index interventions where pasta is included as part of the intervention	Higher glyceic index diets where pasta is not included as part of the intervention	Body weight Body mass index (BMI) Body Fat (%) Waist circumference Waist-to-hip ratio

a Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart LA and PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Systematic Reviews 2015; 4:1. <https://doi.org/10.1186/2046-4053-4-1>

Supplement Table S4a: Trial characteristics

Overweight/Obese Trials														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Karl et al. 2015 †††	39 (19M:20F)**	OB, OP					2.33	USA	P	Negative+ Neutral	17		CR to 2/3kcal; Metabolic	Agency
Low GI	20		56 (5)*	92.9 (13.6)*	32.3 (3.4)*	42:133						68:15:16		
Higher GI	19		56 (5)*	94 (9.7)*	33.4 (2.6)*	61:201						70:16:14		
Pereira et al. 2015	19 (4M:15F)**	OW, IP/OP					NR	Brazil	P	Neutral	6.4		Ad libitum	Unknown
Low GI	10		28(5)	80.0(12.6)	29.9 (2.1)	41.2(2.2) ¥ **						48.3:16.1:32.8		
Higher GI	9		26(3)	79.1(12.2)	29.1 (2.0)	74.1(2.9) ¥ **						54.6:12.7:34.4		
Buscemi et al. 2013	40 (19M:21F)**	OW/OB, high CVD risk, OP					NR	Italy	P	Negative	12		CR to 20kcal/kg/d; Ad libitum	Unknown
Low GI	19		51 (8)	93.8 (17.3)	34.3 (6.6)	48.1: 138						56:18:26		
Higher GI	21		49 (8)	93.2 (14.4)	34.5 (5.1)	59.3: 174						57:16:27		
Costa et al. 2012	17 (7M:10F)	OW, IP/OP	25.4 (5.8)	84.1(16.3)	26.3(3.2)		NR	Brazil	C	Neutral	4		Ab libitum,2 meals+3 fruit/d provided	NR
Low GI						47.5(3.8)						58.6:13.9:25.5		
Higher GI						61.6(2.8)						55.4:14.2:30.3		
Jebb et al. 2010 - High MUFA	225**	OH, some CV risk factors, OP	~52		~28.5 ⁺		1.75	UK	P	Neutral	24		Ad Libitum, key foods provided	Agency, foods by industry
Low GI	115			83.7 (69.6-93.1)¶¶¶		~55.2						~44.6:16.4:35.7****		
Higher GI	110			80.5 (70.0-92.1)¶¶¶		~63.3						~44.9:15.3:35.6****		
Jebb et al. 2010 - Low Fat	250**	OH, some CV risk factors, OP	~52		~28.5 ⁺		3.5	UK	P	Neutral	24		Ad Libitum, key foods provided	Agency, foods by industry
Low GI	117			79.4 (70.1- 91.8)¶¶¶		~56.3						~51.5:14.2:26.1****		
Higher GI	111			80.7 (71.4- 91.4)¶¶¶		~64.4						~51.1:15.7:27.5****		
Larsen et al. 2010-High Pro	231**	OW/OB, OP			NR		NR	Europe	P	Neutral	26		Ad libitum	Agency
Low GI	124		42.1 (6.5)	88.5 (15.6)		~56.5: 108.9						~43:22:32		
Higher GI	107		42 (5.7)	89.5 (17.1)		~61.4: 113.1						~45:23:31		
Larsen et al. 2010 - Low Pro	203 **	OW/OB, OP			NR		NR	Europe	P	Neutral	26		Ad libitum	Agency
Low GI	106		42.2 (5.7)	88.4 (15.7)		~56.2: 121						~51:18:30		
Higher GI	97		42 (5.9)	86.6 (13.8)		~61.6: 137.9						~51:17:31		

Supplement Table S4b: Trial characteristics continued

Overweight/Obese Trials continued															
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source	
Solomon et al. 2010	22 (8M:14F)**	OB, Pre-T2DM, OP					7	USA	P	Neutral	12		Metabolic plus exercise program	Agency	
Low GI	10 (3M:7F)		67 (6)	97.4 (12.0)	34.9 (1.1)	39.8 (0.9)						54.7(0.3):28.3(0.3):17.0(0.3)			
Higher GI	12 (5M:7F)		64 (3)	94.7 (15.2)	34.1 (1.1)	80.0 (2.1)						55.6(0.7):27.8(0.7):16.6(0.3)			
Philippou et al. 2009- 6 mo	38**	≥1 CHD risk factors, OP	(35-65) ¶				NR	UK	P	Negative (for all but n=2)	24		500kcal CR; Ad libitum	Agency	
Low GI	22			91.3(14.8)***	29.1 (3.6)***	50.6 (4.6): 114.4(31.5)									
Higher GI	16			97.5(16.4)***	30.5 (3.5)***	63.2(5.6): 175.0(45.6)									
Philippou et al. 2009- 4 mo	42**	OW, OP	(18-65)¶				NR	UK	P	Neutral	16		Ad libitum	Unknown	
Low GI	23			87.2 (15.3)	32.5 (4.8)	49.7(5.7):89.7(27.5)						47.6(6.7):19.5(4.2):31.8(5.8)			
Higher GI	19			83.6 (13.4)	31.3 (4.8)	63.7(9.4):136.8(56.3)						48.9(7):19.3(4.9):30.9(9)			
Abete et al. 2008	32 (18M:14F)	OB, OP	36(7)				2.33	Spain	P	Negative	8		30% CR; Ad libitum, 3-day menus	Agency	
Low GI	16			94.3(16.1)	32.8 (4.3)	(40-45)¶						50.2 (1.8):18.3(1.6):31.5(1.6)			
Higher GI	16			94.4(13.1)	32.2 (4.4)	(60-65)¶						47.8(6.8):19.6(5.6):32.6(4.3)			
Aston et al. 2008	19 (0M:19F)**	OW/OB, OP	51.9(7.6)	87.5 (15)	33.1 (4.9)		3.33	UK	C	Neutral	12		Ad libitum, key CHO foods provided	Agency	
Low GI						55.5(3.8): 133.8(22.9)*****						51.4(6.0):17.0(2.4):32.2(5.1)* ***			
Higher GI						63.9(3): 138.8(30.5)*****						47.6(6.1):17.6(3.3):34.1(5.7)* ***			
Jensen et al. 2008	44 (0M:44F)**	OW, OP	(20-40)¶				3	Denmark	P	Neutral	10		Ad libitum, partial provision, menu plans	Agency, Industry	
Low GI	22 (0M:22F)			77.9(6.9)	27.4 (1.5)	72¥						~57(5):17(0):23(5) ‡			
Higher GI	22 (0M:22F)			80.2(1.4)	27.6 (0.3)	95¥						~57(5):17(0):22(5) ‡			
Philippou et al. 2008	13 (5M:8F)**	≥1 CHD risk factors, OP					NR	UK	P	Negative	12		500kcal CR; Ad libitum	Agency	
Low GI	7 (3M:4F)		54 (49-58)¶¶	81.5 (4.7)***	28.7 (2.1)***	51.3(51.0-52.0): 105.6 (76.9-110.1)¶¶						46.0(37.8-51.0): 17.1(15.7-17.4): 32.8(31.3-37.1)¶¶			
Higher GI	6 (2M:4F)		45 (39-50)¶¶	89.7 (12.8)***	31.5 (4.4)***	59.3(59.2-64.0): 114.7(98.5-134.9)¶¶						49.4(47.8-51.7):19.6(14.0-23.1):29.2(25.2-34.5)¶¶			

Supplement Table S4c: Trial characteristics continued

Overweight/Obese Trials continued														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Bellisile et al. 2007	65 (0M:65F)**	OW/OB, OP					NR	France	P	Neutral	12		Ad libitum	Industry
Low GI	35		46.1 (13.6)	80 (13.2)	30.2 (4.1)	na								
Higher GI	30		45.3 (12.0)	79 (13.1)	30.4 (4.4)	na								
de Rougemont et al. 2007	38 (22M:16F)**	OW, OP					2.8	France	P	Neutral	5		Ad libitum, some foods provided	Agency, Industry
Low GI	19		36.3 (8.7)	77.2 (9.6)	27.5 (1.3)	46.5 (1.3)						42.6 (3.9):19.8 (1.7):37.7 (4.4)		
Higher GI	19		40.4 (9.6)	77.3 (9.2)	27.2 (1.3)	66.3 (2.6)						44.1 (3.5):17.6 (1.7):38.4 (3.1)		
Sichieri et al. 2007	123 (0M:123F)**	OW, OP					NR	Brazil	P	Negative	72		100-300kcal CR; 6-d menu and exchange lists provided	Agency
Low GI	63		37.2 (5.4)*	67.7 (6.6)*	na	21(38): 74(84)						59.5 (6.3): 13.3: 27.2(4.6)		
Higher GI	60		37.5 (5.6)*	68.5 (7.5)*	na	51(28): 199(43)						61.6 (6.2): 12.3: 26.1(4.7)		
McMillian-Price et al. 2006-High Carb	64(16M:48F)	OW/OB, OP					NR	Australia	P	Negative	12		Ad libitum, key foods and meals provided	Agency-Industry
Low GI	32		30.5 (7.9)	87.1 (15.3)	30.6 (4.5)	45 (6):89 (28)						56 (6):19 (0):22 (6)		
Higher GI	32		31.8 (9.6)	86 (10.7)	30.9 (3.4)	70 (6):129 (45)						60 (6):18 (6):19 (6)		
McMillian-Price et al. 2006-High Protein	65(15M:50F)	OW/OB, OP					NR	Australia	P	Negative	12		Ad libitum, key foods and meals provided	Agency-Industry
Low GI	33		34.6 (8.6)	88.4 (17.2)	32.1 (5.2)	44 (6):59 (23)						40 (11):26 (6):28 (6)		
Higher GI	32		30.2 (8.5)	87.7 (16.4)	31.3 (4.5)	59 (6):75 (17)						42 (6):28 (6):27 (6)		
Wolever et al. 2002	24 (5M:19F)**	IGT, OP					NR	Canada	P	Neutral	16		Ad libitum, partial provision	Agency
Low GI	13(3M:10F)		55.2 (10.8)	79.7 (13.1)***	29.7 (4.3)	54.4 (2.5):91.8 (9.4)						54.8 (6.1):19.4 (1.8):24.7 (5.8)		
Higher GI	11(2M:9F)		58.8 (13.3)	76.4 (20.4)***	29.3 (7.3)	59.3 (2.0):96.8 (11.6)						52.8 (6.6):17.4 (2.3):27.9 (6.3)		

Supplement Table S4d: Trial characteristics continued

Diabetes Trials														
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶ ¶ ¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source
Jenkins et al. 2014	141(77M:64F)	T2DM, OP						NR	Canada	P	Neutral	12		Ad libitum, bread supplement Industry Association
Low GI	70 (38M:32F)		59 (10)	85 (20)	30 (5)	~51:53						~38.5:19.8:37.2		
Higher GI	71 (39M:32F)		59 (10)	84 (19)	31 (6)	~62:89						~49.2:19.8:27.4		
Visek et al. 2014	20 (12M:8F)	T2DM, OP	62.7 (5.8)	91.9 (14.1)	32 (4.2)			NR	Czech Republic	C	Neutral	12		Ad libitum Agency
Low GI						49 (48-51)¶¶¶						~37.2:18.0:36.0		
Higher GI						68 (61-72)¶¶¶						~36.2:17.3:40.0		
Jenkins et al. 2012	121 (61M: 60F)	T2DM, OP						NR	Canada	P	Neutral	12		Ad libitum Agency
Low GI	60		58 (10.1)	85.6 (20.1)	31.4 (7.0)	47: 80						45.4:22.8:30.5		
Higher GI	61		61 (7.8)	82.5 (17.2)	29.9 (5.5)	58: 100						48.3:21.4:28.5		
Yusof et al. 2009	100**	T2DM, OP	NR					NR	Malaysia	P	Neutral	12		Ad libitum, key foods provided to lowGI group Agency
Low GI	51			69.12 (13.33)	27.05 (4.91)	57(6): 108(32)						52(4):18(3):30(4)		
Higher GI	49			66.83 (11.50)	26.79 (4.65)	64(5): 131(30)						54(4):17(3):28(5)		
Jenkins et al 2008	210 (125M:82F)	T2DM, OP						NR	Canada	P	Neutral	24		Ad libitum Agency
Low GI	106 (65M:41F)		60 (10)	87.0 (20.0)	30.6 (6.0)	49.4: 91.5						44.0:21.2:33.3		
Higher GI	104 (63M:41F)		61 (9)	87.8 (19.4)	31.2 (5.8)	59.3: 117.9						47.5:20.7:30.5		
Wolever et al. 2008	103	T2DM, OW/OB, OP						NR	Canada	P	Neutral	52		Ad libitum, key foods provided Agency
Low GI	55		60.6 (7.5)*	81.1 (18.7)*	31.6 (4.5)*	55.1 (3.0): 133 (14.8)						51.9 (6.7):20.6(3.0):26.5 (5.9)		
Higher GI	48		60.4 (7.9)*	84.4(18.0)*	30.1 (4.3)*	63.2 (2.8): 135 (20.8)						46.5 (6.2):20.4 (2.8):30.8 (4.8)		

Supplement Table S4e: Trial characteristics continued

Diabetes Trials continued															
Study	Subjects	Sample Description	Mean Age (y) (SD)	Mean Baseline Body Weight (kg) (SD)	Mean Baseline BMI (kg/m ²) (SD)	Mean GI:GL of diet (SD) ¶¶¶	Pasta Dose (serv/wk)	Setting	Design	Energy Balance§	Duration (wks)	Diet Composition % (SD)§§	Dietary Prescription	Funding Source	
Jimenez-Cruz et al. 2003	14 (6M:8F)**	T2DM, OP	59 (34)					NR	Mexico	C	Neutral	6	60:21:23	Ad libitum	Industry
Low GI				91.6 (24.3)	32.4 (6.0)	44(3.4): 86(19.8)									
Higher GI				92.6 (25.4)	32.3 (6.0)	56(4.9): 139(27.3)						64:18:20			
Heilbronn et al. 2002	45 (23M:22F)**	T2DM, OW, OP						3.5	Australia	P	Negative	8		CR to1500kcal/d; Ad libitum, partial provision	Unknown
Low GI	24 (11M:13F)		56.0(9.4)	91.7(16.2)		43						58.9 (2.9):22.2 (1.5):17.9 (3.9)			
Higher GI	21 (12M:9F)		57.5(9.6)	93.2 (13.3)		75						60.8 (2.3):21.7 (0.9):17.1 (2.3)			
Fontvieille et al. 1992	18 (12M:6F)	T1DM/T2DM, OP	47.2(11.6)		24.8(2.6)			4.7	France	C	Neutral	5		Ad libitum	Agency, Industry
Low GI						38.1(5.3)						45.8(7.2):18.0(2.5):36.2(6.8)			
Higher GI						64.2(3.1)						44.9(7.3):18.8(1.6):36.3(6.0)			
Fontvieille et al. 1988	8 (4M:4F)	T1DM, OP	43.5 (9.9)		24.1 (6.8)			3.5	France	C	Neutral	3		Ad libitum, partial provision	Agency, Industry
Low GI						46.5(2.5)						46.1 (4.5):17.4 (1.4):35.0 (2.8)			
Higher GI						60.1 (5.1)						45.4 (4.5):16.9 (1.7):36.0 (2.8)			
CHD Trial															
Frost et al. 2004	55 (48M:7F)**	CHD, OP						NR	UK	P	Neutral §§§	12		Ad Libitum	Unknown
Low GI	26 (23M:3F)		63.6 (9.4)	81.2 (12.2)	26.9 (3.3)	50(4):115(39)						49 (5):18 (5):31 (5)			
Higher GI	29 (25M:4F)		61.8 (9)	81.7 (16.7)	28.7 (4.6)	57(4):106(34)						47 (10):18 (5):32 (10)			

Abbreviations: BMI=Body Mass Index; C=Crossover design; Carb=Carbohydrate; CED= carbohydrate exchange diet; CHD= Coronary Heart Disease; CR= calorie restriction; CV=cardiovascular; GI= glycemic index; GL=glycemic load; IGT= impaired glucose tolerance; IP=inpatient; IR= insulin resistant; High Carb= high carbohydrate; HI= hyperinsulinemic; M = male; mo=months; MUFA=monounsaturated fatty acids; na=not available; T1DM=type 1 diabetes mellitus; T2DM = type 2 diabetes mellitus; OB= obese; OH=otherwise healthy; OP = outpatient; OW= overweight; P=Parallel design; SD= standard deviation; F = female; UK= United Kingdom; USA= United States of America; wks=weeks; y= years

§Negative energy balance diets were designed for weight loss, Neutral energy balance diets for weight maintenance, where all diets are isocaloric between test and control groups; §§Energy from carbohydrate: protein: fat for the planned diet or if not planned; §§§ Participants were advised to lose weight if they had a BMI>28kg/m2.

¶ Range of values; ¶¶ median and interquartile range (IQR); ¶¶¶ Actual GI/GL or if not available, planned;

* Calculated before dropout; **Completer Analysis, as used in data analysis; *** completer analysis, data obtained from authors; **** based on less participants than in analysis;

+ approximate based on all study arms; ¥ approximate based on test meals; ‡ approximate based on n=45 from Sloth et al. 2004, the original publication of this study;

‡‡‡ analysis includes weight loss and weight maintenance phases

Supplemental Table S5: Sensitivity analysis of the systematic removal of each trial*

	MD [95% CI], P-value I ² , P-value					
	Body Weight (kg) N=32	BMI (kg/m ²) N=18	Body Fat (%) N=10	Waist Circumference (cm) N=18	Waist-to-hip Ratio N=6	Sagittal Abdominal Diameter (cm) N=3
All studies	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.91	-0.01 [-0.58, 0.56], P=0.98 65%, P=0.003	-0.46 [-1.05, 0.14], P=0.13 62%, P<0.01	-0.00 [-0.01, 0.00], P=0.27 0.00%, P=0.52	-0.09 [-0.34, 0.16], P=0.48 0.00%, P=0.92
Removal of:						
OW/OB						
Pereira et al. 2015	-0.61 [-0.82, -0.39], P<0.01 0.00%, P=0.54	-0.24 [-0.34, -0.14], P<0.01 0.00%, P=0.93	0.19 [-0.25, 0.63], P=0.39 36%, P=0.13	-0.37 [-1.04, 0.31], P=0.28 62%, P<0.01	-0.00 [-0.01, 0.01], P=0.67 0.00%, P=0.58	n/a
Karl et al. 2015	-0.62 [-0.83, -0.41], P<0.01 0.00%, P=0.50	-0.25 [-0.35, -0.16], P<0.01 0.00%, P=0.91	0.10 [-0.51, 0.71], P=0.74 64%, P<0.01	n/a	n/a	n/a
Buscemi et al. 2013	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.86	-0.08 [-0.63, 0.48], P=0.79 64%, P<0.01	-0.46 [-1.06, 0.15], P=0.14 64%, P<0.01	n/a	n/a
Costa et al. 2012	-0.62 [-0.84, -0.41], P<0.01 0.00%, P=0.46	-0.26 [-0.37, -0.16], P<0.01 0.00%, P=0.86	-0.06 [-0.73, 0.61], P=0.86 66%, P<0.01	-0.33 [-0.94, 0.28], P=0.29 59%, P<0.01	n/a	n/a
Jebb et al. 2010 - LowFat	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Larsen et al. 2010 - LowPro	-0.60 [-0.81, -0.38], P<0.01 0.00%, P=0.57	n/a	n/a	-0.45 [-1.09, 0.18], P=0.16 64%, P<0.01	n/a	-0.05 [-0.39, 0.29], P=0.79 0.00%, P=0.86
Jebb et al. 2010- HighMUFA	-0.64 [-0.85, -0.43], P<0.01 0.00%, P=0.65	n/a	n/a	n/a	n/a	n/a
Larsen et al. 2010 - HighPro	-0.62 [-0.83, -0.41], P<0.01 0.00%, P=0.48	n/a	n/a	-0.37 [-1.00, 0.26], P=0.26 62%, P<0.01	n/a	-0.13 [-0.45, 0.19], P=0.42 0.00%, P=0.92
Solomon et al. 2010	-0.63 [-0.84, -0.42], P<0.01	-0.26 [-0.36, -0.16], P<0.01	n/a	n/a	n/a	n/a

	0.00%, P=0.47	0.00%, P=0.88				
Philippou et al. 2009 - 6mnth	-0.65 [-0.86, -0.44], P<0.01 0.00%, P=0.59	-0.28 [-0.37, -0.18], P<0.01 0.00%, P=0.97	-0.12 [-0.71, 0.48], P=0.70 65%, P<0.01	-0.55 [-1.15, 0.04], P=0.07 61%, P<0.01	n/a	n/a
Philippou et al. 2009 - 4mnth	-0.61 [-0.83, -0.40], P<0.01 0.00%, P=0.48	-0.25 [-0.35, -0.15], P<0.01 0.00%, P=0.89	-0.09 [-0.72, 0.54], P=0.78 66%, P<0.01	-0.44 [-1.08, 0.19], P=0.17 64%, P<0.01	n/a	n/a
Abete et al. 2008	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	n/a	n/a	n/a	n/a	n/a
Philippou et al. 2008	-0.62 [-0.83, -0.42], P<0.01 0.00%, P=0.48	-0.26 [-0.35, -0.16], P<0.01 0.00%, P=0.89	-0.06 [-0.68, 0.55], P=0.84 68%, P<0.01	-0.41 [-1.02, 0.19], P=0.18 63%, P<0.01	n/a	n/a
Aston et al. 2008	-0.66 [-0.87, -0.44], P<0.01 0.00%, P=0.52	n/a	-0.00 [-0.70, 0.69], P=0.99 68%, P<0.01	-0.54 [-1.14, 0.07], P=0.08 62%, P<0.01	n/a	n/a
Jensen et al. 2008	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.27 [-0.36, -0.17], P<0.01 0.00%, P=0.88	n/a	-0.44 [-1.05, 0.18], P=0.16 64%, P<0.01	-0.00 [-0.01, 0.00], P=0.24 0.00%, P=0.41	-0.09 [-0.35, 0.18], P=0.51 0.00%, P=0.69
de Rougemont et al. 2007	-0.57 [-0.80, -0.34], P<0.01 0.00%, P=0.53	-0.25 [-0.36, -0.14], P<0.01 0.00%, P=0.87	0.06 [-0.57, 0.70], P=0.84 67%, P<0.01	n/a	n/a	n/a
Sichieri et al. 2007	-0.66 [-0.88, -0.45], P<0.01 0.00%, P=0.53	n/a	n/a	n/a	n/a	n/a
Bellisle et al. 2007	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.88	n/a	-0.47 [-1.08, 0.13], P=0.13 64%, P<0.01	-0.00 [-0.01, 0.00], P=0.14 0.00%, P=0.70	n/a
McMillan-Price et al. 2006 - HighCHO	-0.61 [-0.82, -0.39], P<0.01 0.00%, P=0.51	n/a	n/a	-0.38 [-1.01, 0.25], P=0.23 63%, P<0.01	n/a	n/a
McMillan-Price et al. 2006 - HighPro	-0.70 [-0.91, -0.49], P<0.01 0.00%, P=0.91	n/a	n/a	-0.62 [-1.19, -0.05], P=0.03 55%, P<0.01	n/a	n/a
Wolever et al. 2002	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Diabetes:						
Vissek et al. 2014	-0.63 [-0.84, -0.42], P<0.01	-0.26 [-0.36, -0.16], P<0.01	0.01 [-0.57, 0.60], P=0.96	n/a	n/a	n/a

	0.00%, P=0.46	0.00%, P=0.86	68%, P<0.01			
Jenkins et al. 2014	-0.66 [-0.88, -0.43], P<0.01 0.00%, P=0.47	-0.29 [-0.39, -0.18], P<0.01 0.00%, P=0.94	n/a	-0.61 [-1.18, -0.04], P=0.04 50%, P=0.01	-0.00 [-0.01, 0.00], P=0.21 0.00%, P=0.43	n/a
Jenkins et al. 2012	-0.62 [-0.84, -0.40], P<0.01 0.00%, P=0.46	-0.25 [-0.35, -0.15], P<0.01 0.00%, P=0.87	n/a	-0.44 [-1.05, 0.17], P=0.16 64%, P<0.01	-0.00 [-0.01, 0.01], P=0.64 0.00%, P=0.53	n/a
Yusof et al. 2009	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.87	n/a	-0.33 [-0.95, 0.28], P=0.29 58%, P<0.01	n/a	n/a
Jenkins et al. 2008	-0.61 [-0.83, -0.40], P<0.01 0.00%, P=0.48	-0.25 [-0.36, -0.15], P<0.01 0.00%, P=0.87	n/a	n/a	n/a	n/a
Wolever et al. 2008	-0.64 [-0.84, -0.43], P<0.01 0.00%, P=0.57	n/a	n/a	-0.50 [-1.10, 0.09], P=0.10 62%, P<0.01	n/a	n/a
Jimenez-Cruz et al. 2003	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	-0.26 [-0.35, -0.16], P<0.01 0.00%, P=0.86	n/a	n/a	n/a	n/a
Heilbronn et al. 2002	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	n/a	n/a	n/a	n/a	n/a
Fontvieille et al. 1992	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
Fontvieille et al. 1988	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.46	n/a	n/a	n/a	n/a	n/a
CHD						
Frost et al. 2004	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.47	-0.26 [-0.36, -0.17], P<0.01 0.00%, P=0.89	n/a	-0.48 [-1.09, 0.12], P=0.12 63%, P<0.01	-0.00 [-0.01, 0.00], P=0.25 1%, P=0.40	n/a

*Sensitivity analysis included the removal of each single study from the meta-analyses one at a time and the summary effect was recalculated. An influential outlier was considered a study whose removal changed the magnitude of the pooled effect by >10%.

BMI, body mass index; CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; MD, mean difference; mnth, month; MUFA, monounsaturated fatty acids; n/a, not applicable; OB, obese; OW, overweight; Pro, protein

Supplemental Table S6: Sensitivity analyses of the use of correlation coefficients of 0.25 and 0.75 for crossover trials

Outcome (no. crossover trials/total)	MD (95% CI), P-value I ² , P-value		
	Correlation Coefficient used in the Primary Analysis	Correlation Coefficient used in Sensitivity Analyses	
	0.5	0.25	0.75
Body Weight, kg (6*/32)	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.63 [-0.84, -0.42], P<0.01 0.00%, P=0.51	-0.63 [-0.84, -0.43], P<0.01 0.00%, P=0.51
BMI, kg/m ² (3/18)	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.91	-0.26 [-0.36, -0.16], P<0.01 0.00%, P=0.90	-0.26 [-0.35, -0.17], P<0.01 0.00%, P=0.90
Body Fat, % (3*/10)	-0.01 [-0.58, 0.56], P=0.98 65%, P<0.01	-0.00 [-0.58, 0.58], P=0.99 64%, P<0.01	-0.02 [-0.57, 0.54], P=0.96 66%, P<0.01
Waist Circumference, cm (2*/18)	-0.46 [-1.05, 0.14], P=0.13 62%, P<0.01	-0.44 [-1.04, 0.15], P=0.14 60%, P<0.01	-0.46 [-1.07, 0.14], P=0.13 65%, P<0.01
Waist-to-hip Ratio (0/6)	-0.00 [-0.01, 0.00], P=0.27 0.00%, P=0.52	n/a	n/a
Sagittal Abdominal Diameter, cm (0/6)	-0.09 [-0.34, 0.16], P=0.48 0.00%, P=0.92	n/a	n/a

* one of these crossover trials, however, did not require the use of a correlation coefficient as complete data was available

BMI, body mass index; CI, confidence interval; MD, mean difference; no., number

Supplement Table S7. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on body weight (kg)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	24.1 – 37.1 kg/m ²	32	2448	-0.04 (-0.13, 0.06)	0.00%	0.454
Follow-up	3 – 72 wks	32	2448	0.01 (-0.01, 0.02)	0.00%	0.314
Dose Pasta	1.75 – 7.0 serv/wk	11	740	0.29 (-0.91, 1.50)	0.00%	0.595
GI ³	21 - 72	31	2383	-0.01 (-0.04, 0.02)	0.45%	0.482
Difference in GI ²	4.9 - 40.2	31	2383	-0.00 (-0.04, 0.03)	2.75%	0.811
Fiber ³	8.0 - 39.4g/d	27	1851	0.02 (-0.01, 0.06)	0.00%	0.221
Change in Fiber ⁴	-7.5 - +13.8g/d	17	1571	-0.02 (-0.07, 0.04)	23.13%	0.595
Difference in Fiber ²	-8.5 - +15.3g/d	27	1851	-0.01 (-0.06, 0.04)	0.00%	0.701
Saturated Fat ³	5.1 - 12.5%	14	1396	-0.05 (-0.30, 0.20)	34.32%	0.648
Change in Saturated Fat ⁴	-8.2 - -1.2%	12	1309	-0.01 (-0.29, 0.28)	46.27%	0.965
Difference in Saturated Fat ²	-2.0 - +2.3%	14	1396	-0.34 (-1.08, 0.39)	32.80%	0.329
CHO ³	37.2 - 68.0%	30	2345	-0.01 (-0.05, 0.03)	0.00%	0.541
Change in CHO ⁴	-7.2 - +10.1%	19	2046	-0.07 (-0.12, -0.01)	0.00%	0.016
Difference in CHO ²	-11.1 - +5.4%	30	2345	0.02 (-0.05, 0.10)	0.00%	0.547
Protein ³	13.3 - 26.1%	30	2345	0.04 (-0.04, 0.12)	0.00%	0.332

Change in Protein ⁴	-0.5 - +8.6%	19	2046	0.15 (0.03, 0.27)	0.00%	0.017
Difference in Protein ²	-2.5 - +3.4%	30	2345	-0.18 (-0.38, 0.02)	0.00%	0.069
Fat ³	16.0 - 37.7%	30	2345	0.01 (-0.05, 0.06)	0.00%	0.852
Change in Fat ⁴	-12.2 - +5.4%	19	2046	0.05 (-0.02, 0.12)	17.73%	0.122
Difference in Fat ²	-4.4 - +10.6%	30	2345	0.02 (-0.05, 0.09)	0.00%	0.610

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in body weight on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in body weight. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index

Supplemental Table S8. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on BMI (kg/m²)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 37.1 kg/m ²	18	1038	-0.01 (-0.06, 0.03)	0.00%	0.559
Follow-up	4 – 24 wks	18	1038	0.00 (-0.01, 0.02)	0.00%	0.559
Dose Pasta*	2.33 – 7.0 serv/wk	4	143			
GI ³	39.8 - 72	17	973	0.01 (-0.01, 0.03)	0.00%	0.153
Difference in GI ²	7.0 - 40.2	17	973	-0.01 (-0.03, 0.01)	0.00%	0.275
Fiber ³	8.0 - 39.4g/d	16	935	0.01 (-0.01, 0.02)	0.00%	0.366
Change in Fiber ⁴	-1.8 - +12.4g/d	10	758	0.00 (-0.03, 0.03)	0.00%	0.846
Difference in Fiber ²	-4.9 - +13.0g/d	16	935	-0.00 (-0.02, 0.02)	0.00%	0.821
Saturated Fat* ³	7.6 - 12.5%	7				
Change in Saturated Fat* ⁴	-2.4 - -1.2%	6				
Difference in Saturated Fat* ²	-1.0 - +2.3%	7				
CHO ³	37.2 - 68.0%	16	935	-0.00 (-0.02, 0.01)	0.00%	0.594
Change in CHO ⁴	-5.6 - +3.2%	10	758	-0.02 (-0.06, 0.02)	0.00%	0.325
Difference in CHO ²	-11.1 - +2.0%	16	935	-0.01 (-0.03, 0.02)	0.00%	0.531
Protein ³	13.9 – 22.8%	16	935	0.00 (-0.04, 0.04)	0.00%	0.905

Change in Protein ⁴	-0.2 - +3.0%	10	758	0.01 (-0.11, 0.14)	0.00%	0.786
Difference in Protein ²	-2.5 - +3.4%	16	935	-0.03 (-0.12, 0.06)	0.00%	0.441
Fat ³	16.0 - 37.7%	16	935	0.00 (-0.02, 0.02)	0.00%	0.717
Change in Fat ⁴	-4.8 - +5.4%	10	758	0.02 (-0.02, 0.06)	0.00%	0.240
Difference in Fat ²	-4.4 - +10.6%	16	935	0.01 (-0.01, 0.04)	0.00%	0.299

*For Dose, there were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in BMI on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in BMI. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplemental Table S9. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on body fat (%)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 36.0 kg/m ²	10	285	-0.02 (-0.26, 0.23)	67.69%	0.890
Follow-up	4 – 24 wks	10	285	0.06 (-0.06, 0.17)	66.00%	0.303
Dose Pasta*	2.33 - 3.33 serv/wk	3	96			
GI ³	39.8 - 72	10	285	0.12 (-0.00, 0.25)	52.21%	0.053
Difference in GI ²	7.0 - 40.2	10	285	-0.09 (-0.15, -0.03)	19.39%	0.008
Fiber* ³	8.0 - 39.4g/d	8	228			
Change in Fiber* ⁴	-1.8 - +12.4g/d	4	87			
Difference in Fiber* ²	-4.9 - +13.0g/d	8	228			
Saturated Fat* ³	7.6 - 12.5%	3	93			
Change in Saturated Fat* ⁴	-2.4 - -1.2%	2	51			
Difference in Saturated Fat* ²	-1.0 - +2.3%	3	93			
CHO* ³	37.2 - 68.0%	9	247			
Change in CHO* ⁴	-5.6 - +3.2%	4	87			
Difference in CHO* ²	-11.1 - +2.0%	9	247			
Protein* ³	13.9 – 22.8%	9	247			

Change in Protein* ⁴	-0.2 - +3.0%	4	87			
Difference in Protein* ²	-2.5 - +3.4%	9	247			
Fat* ³	16.0 - 37.7%	9	247			
Change in Fat* ⁴	-4.8 - +5.4%	4	87			
Difference in Fat* ²	-4.4 - +10.6%	9	247			

*There were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in body fat on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in body fat. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplemental Table S10. Continuous meta-regression analysis for the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm)¹

Subgroup	Range	No. trials	N	β (95% CI)	Residual I ²	P value
Baseline BMI	26.3 – 36.0 kg/m ²	18	1380	0.10 (-0.13, 0.32)	59.02%	0.372
Follow-up	4 – 52 wks	18	1380	0.05 (-0.03, 0.13)	60.50%	0.225
Dose Pasta*	3.0 – 3.33 serv/wk	2	63			
GI ³	41.2 – 72.0	17	1315	-0.01 (-0.12, 0.10)	66.00%	0.841
Difference in GI ²	4.9 – 32.9	17	1315	-0.02 (-0.10, 0.06)	64.51%	0.596
Fiber ³	8.0 - 39.4g/d	15	1258	0.05 (-0.05, 0.14)	59.60%	0.342
Change in Fiber ⁴	-1.8 - +13.8g/d	13	1176	0.01 (-0.17, 0.20)	70.59%	0.861
Difference in Fiber ²	-4.9 - +15.3g/d	15	1258	-0.00 (-0.14, 0.13)	64.86%	0.939
Saturated Fat* ³	6.1 – 10.1%	8	604			
Change in Saturated Fat* ⁴	-7.6 - -1.2%	7	562			
Difference in Saturated Fat* ²	-2.0 - +2.3%	8	604			
CHO ³	38.5 - 58.6%	16	1277	-0.11 (-0.19, -0.04)	27.06%	0.007
Change in CHO ⁴	-7.2 - +10.1%	13	1176	-0.09 (-0.23, 0.04)	57.19%	0.148
Difference in CHO ²	-11.1 - +5.4%	16	1277	-0.01 (-0.18, 0.17)	60.81%	0.947
Protein ³	13.9 – 26.1%	16	1277	0.20 (0.01, 0.38)	43.92%	0.038

Change in Protein ⁴	-0.3 - +8.6%	13	1176	0.19 (-0.09, 0.46)	63.38%	0.165
Difference in Protein ²	-2.5 - +3.4%	16	1277	-0.14 (-0.66, 0.38)	62.79%	0.570
Fat ³	22.0 - 37.2%	16	1277	0.10 (-0.05, 0.26)	53.48%	0.185
Change in Fat ⁴	-12.2 - +5.4%	13	1176	0.08 (-0.07, 0.24)	61.15%	0.274
Difference in Fat ²	-4.4 - +10.6%	16	1277	0.09 (-0.06, 0.25)	47.17%	0.220

*There were <10 trials so subgroup analyses were not performed.

1 Data is presented as between group mean difference (95% CI) for a 1-unit change in the predictor variable. β -coefficients were estimated using continuous meta-regression analysis. A positive β -coefficient implies an increase in waist circumference on the pasta/low-GI intervention as the subgroup variable increases, and a negative β -coefficient implies a decrease in waist circumference. Residual I^2 reports inter-study heterogeneity not explained by the subgroup and was estimated using the Cochran's Q statistic.

2 Difference in diet variable between the intervention and control arms

3 Intake at the end of study in the intervention arm

4 Change in intake from end of study from baseline in intervention arm

BMI, body mass index; CHO, carbohydrate; GI, glycemic index; wk, week

Supplementary Table S11. Post-hoc piecewise linear continuous dose-response meta-regression analyses for the effect of pasta intake in the context of low-GI dietary patterns on body weight (kg)

Dose threshold of servings of pasta consumed per week	Dose ranges of servings of pasta consumed per week	β (95% CIs) *	Residual I^2 †	p -value
3.0	≤ 3.0	-0.70 (-3.27, 1.86)	0.00%	0.890
	> 3.0	0.91 (-0.89, 2.70)		
3.33	≤ 3.33	0.05 (-1.80, 1.89)	0.00%	0.518
	> 3.33	0.44 (-1.75, 2.63)		
3.5	≤ 3.5	0.09 (-1.65, 1.82)	0.00%	0.888
	> 3.5	0.46 (-1.89, 2.81)		

* β is the slope derived from the piecewise linear meta-regression analyses and represents the treatment effect on body weight for doses above and below each dose-threshold representing servings of pasta consumption per week; † The residual I^2 value indicates heterogeneity unexplained by each dose-threshold.

Supplementary Table S12: GRADE assessment of study quality

Quality assessment*							№ of patients		Effect	Quality Importance
№ of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Pasta/LGI diet	Higher GI diet	Absolute (95% CI)	
Body Weight (follow up: median 12 weeks)										
32	randomised trials	not serious	not serious	serious ^a	not serious	none	1294	1228	MD -0.63 kg (-0.84 to -0.42)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
BMI (follow up: median 12 weeks)										
18	randomised trials	not serious	not serious	serious ^a	not serious	none	551	538	MD -0.26 kg/m² (-0.36 to -0.16)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
Waist Circumference (follow up: median 12 weeks)										

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Quality assessment*							№ of patients		Effect	Quality Importance
№ of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Pasta/LGI diet	Higher GI diet	Absolute (95% CI)	
18	randomised trials	not serious	serious ^b	serious ^a	not serious	none	717	624	MD -0.46 cm (-1.05 to 0.14)	⊕⊕○○ LOW ^{a,b} Due to downgrade for inconsistency and indirectness
Body Fat (follow up: median 12 weeks)										
10	randomised trials	not serious	serious ^c	serious ^a	not serious	none	176	165	MD -0.01 % (-0.58 to 0.56)	⊕⊕○○ LOW ^{a,c} Due to downgrade for inconsistency and indirectness
Waist-to-hip Ratio (follow up: median 12 weeks)										

Quality assessment*							№ of patients		Effect	Quality Importance
№ of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Pasta/LGI diet	Higher GI diet	Absolute (95% CI)	
6	randomised trials	not serious	not serious	serious ^a	not serious	none ^d	223	222	MD -0.00 (-0.01 to 0.00)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness
Sagittal Abdominal Diameter (follow up: median 26 weeks)										
3	randomised trials	not serious	not serious	serious ^a	not serious	none ^d	237	214	MD -0.09 cm (-0.34 to 0.16)	⊕⊕⊕○ MODERATE ^a Due to downgrade for indirectness

CI, Confidence interval; GI, glycemic index; LGI, low glycemic index; MD, Mean difference

*All outcomes started with high quality evidence since all studies were randomized controlled trials. Risk of Bias – We rated down for risk of bias if the majority of studies were considered to be at high risk of bias. Inconsistency – We assessed inconsistency using I^2 estimates where an I^2 of 50% or higher indicates substantial heterogeneity. I^2 is the percentage of variability in the treatment estimates that is attributable to heterogeneity between studies. We rated down for inconsistency if there was substantial heterogeneity that was unexplained by any a priori sensitivity or subgroup analyses. Indirectness – We rated down for indirectness if there were factors present relating to the population, interventions, and outcomes that limited the generalizability of the results. Imprecision – We rated down for imprecision if the 95% confidence interval (95% CI) crossed the minimally important difference (MID) for harm. MIDs used for each outcome are: 0.5kg for body weight (based on Johnston et al. JAMA 2014;312(9):923-33); 0.2kg/m² for BMI; 2.0cm for waist circumference; 2.0% for body fat; 0.02 for waist-to-hip ratio; 2.0cm for sagittal abdominal diameter.

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3 a. Downgrade for serious indirectness, since most of the available trials did not quantify the amount of pasta consumed in the context
4 of the low-GI dietary patterns
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6 b. Downgrade for serious inconsistency, as there was evidence of substantial inter-study ($I^2=62\%$, P-heterogeneity<0.001), which
7 could not be explained
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9 c. Downgrade for serious inconsistency, as there was evidence of substantial inter-study ($I^2= 65\%$, P-heterogeneity=0.003), which
10 could not be explained
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12 d. No downgrade for publication bias, as publication bias could not be assessed due to lack of power for assessing funnel plot
13 asymmetry and small study effects (<10 trials included in the meta-analysis)
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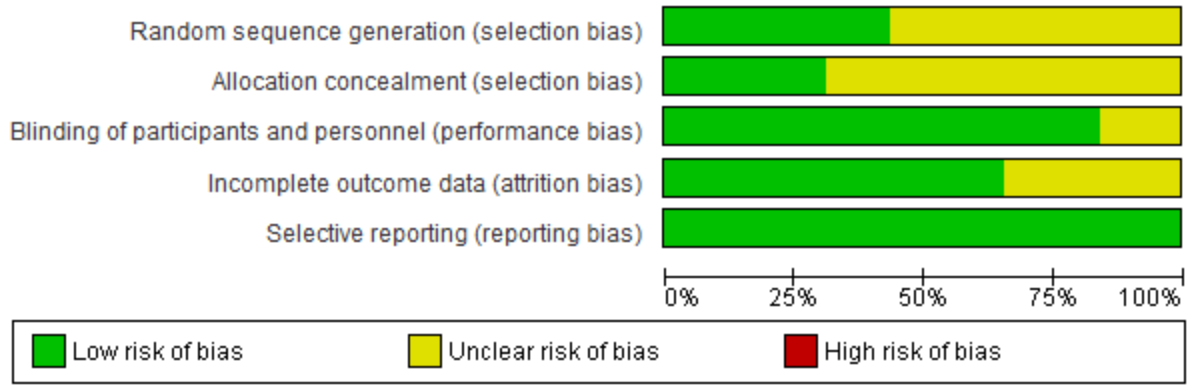
Supplemental Figures

	Random Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel and Outcome Assessment	Incomplete Outcome Data	Selective Reporting		Random Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel and Outcome Assessment	Incomplete Outcome Data	Selective Reporting
Abete et al. 2008	?	?	?	+	+	Jimenez-Cruz et al. 2003	?	?	?	?	+
Aston et al. 2008	+	?	+	+	+	Karl et al. 2015	+	+	+	+	+
Bellisle et al. 2007	?	?	?	?	+	Larsen et al. 2010 -LowPro	+	+	+	+	+
Buscemi et al. 2012	+	+	+	?	+	Larsen et al. 2010 -HighPro	+	+	+	+	+
Cost et al. 2012	?	?	+	+	+	McMillan-Price et al. 2006- HighCHO	?	?	+	+	+
de Rougemont et al. 2007	?	+	+	+	+	McMillan-Price et al. 2006- HighPro	?	?	+	+	+
Fontvielle et al. 1992	?	?	+	+	+	Pereira et al. 2015	?	?	+	?	+
Fontvielle et al. 1988	?	?	+	+	+	Philippou et al. 2008	?	?	+	?	+
Frost et al. 2004	?	?	+	+	+	Philippou et al. 2009-4mo	?	?	+	?	+
Heilbronn et al. 2002	?	?	+	?	+	Philippou et al. 2009-6mo	?	?	?	?	+
Jebb et al. 2010 - HighMUFA	+	?	+	?	+	Sicheri et al. 2007	+	?	+	?	+
Jebb et al. 2010 - LowFat	+	?	+	?	+	Solomon et al. 2010	?	?	+	+	+
Jenkins et al. 2014	+	+	+	+	+	Visek et al. 2014	?	?	+	+	+
Jenkins et al. 2012	+	+	+	+	+	Wolever et al. 2008	+	+	?	+	+
Jenkins et al. 2008	+	+	+	+	+	Wolever et al. 2002	+	+	+	+	+
Jensen et al. 2008	?	?	+	+	+	Yusof et al. 2009	+	?	+	+	+

Supplemental Figure S1: Cochrane risk of bias summary for all included trials

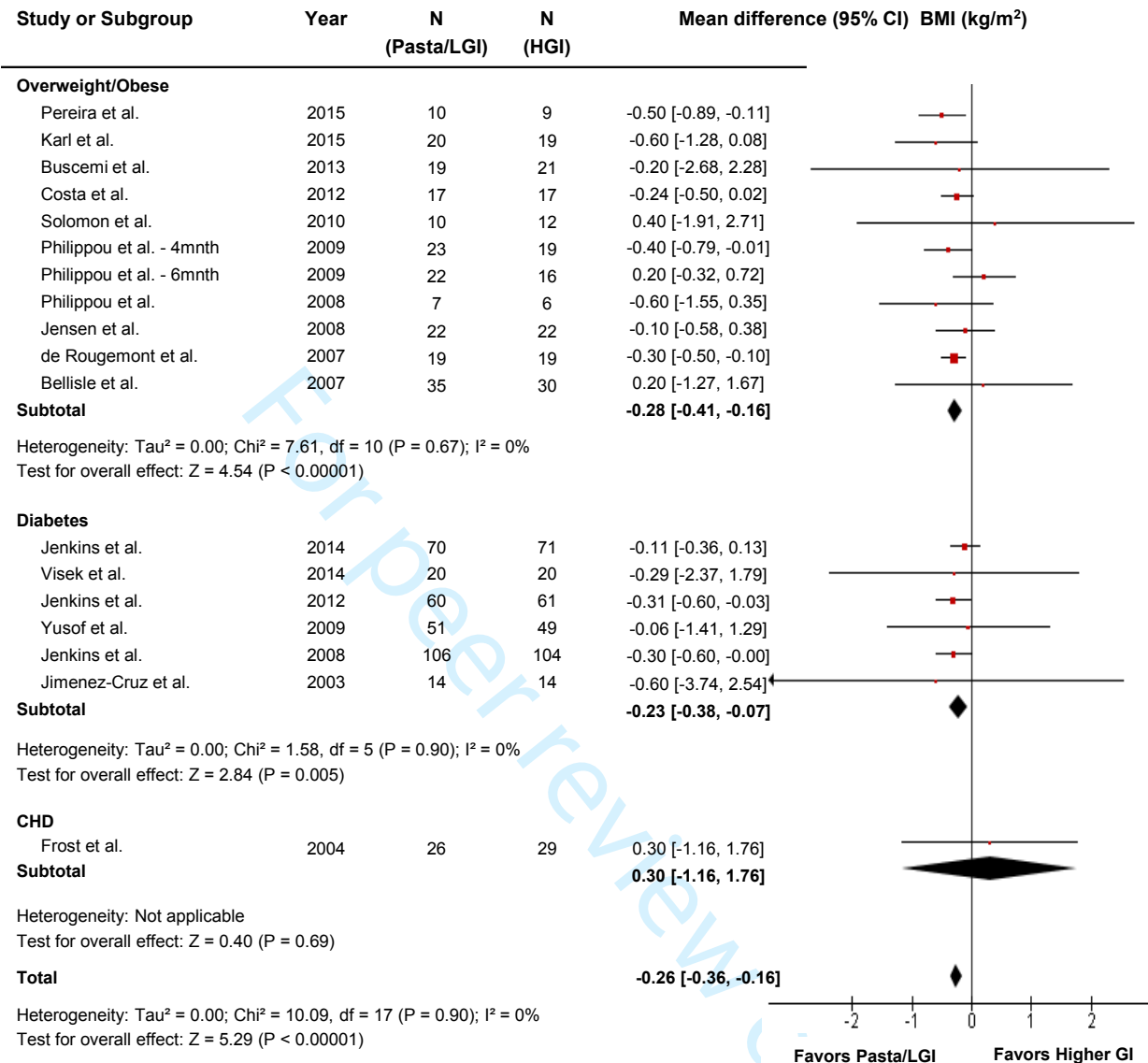
Summary of risk of bias ratings for each individual study included in the meta-analysis.

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Supplemental Figure S2: Risk of bias proportion graph for all included trials

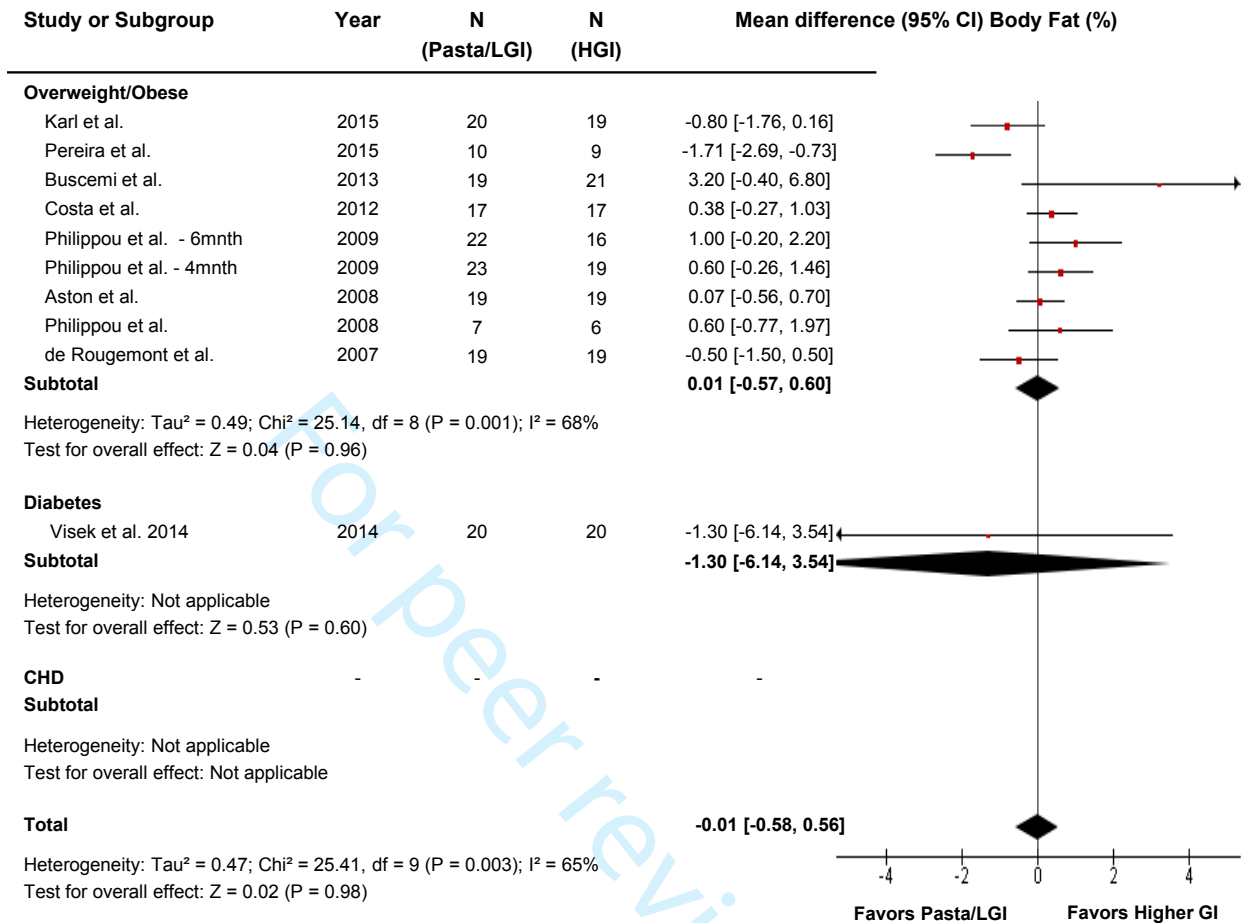
Peer review only



Supplemental Figure S3: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on BMI (kg/m²) (n= 1038)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

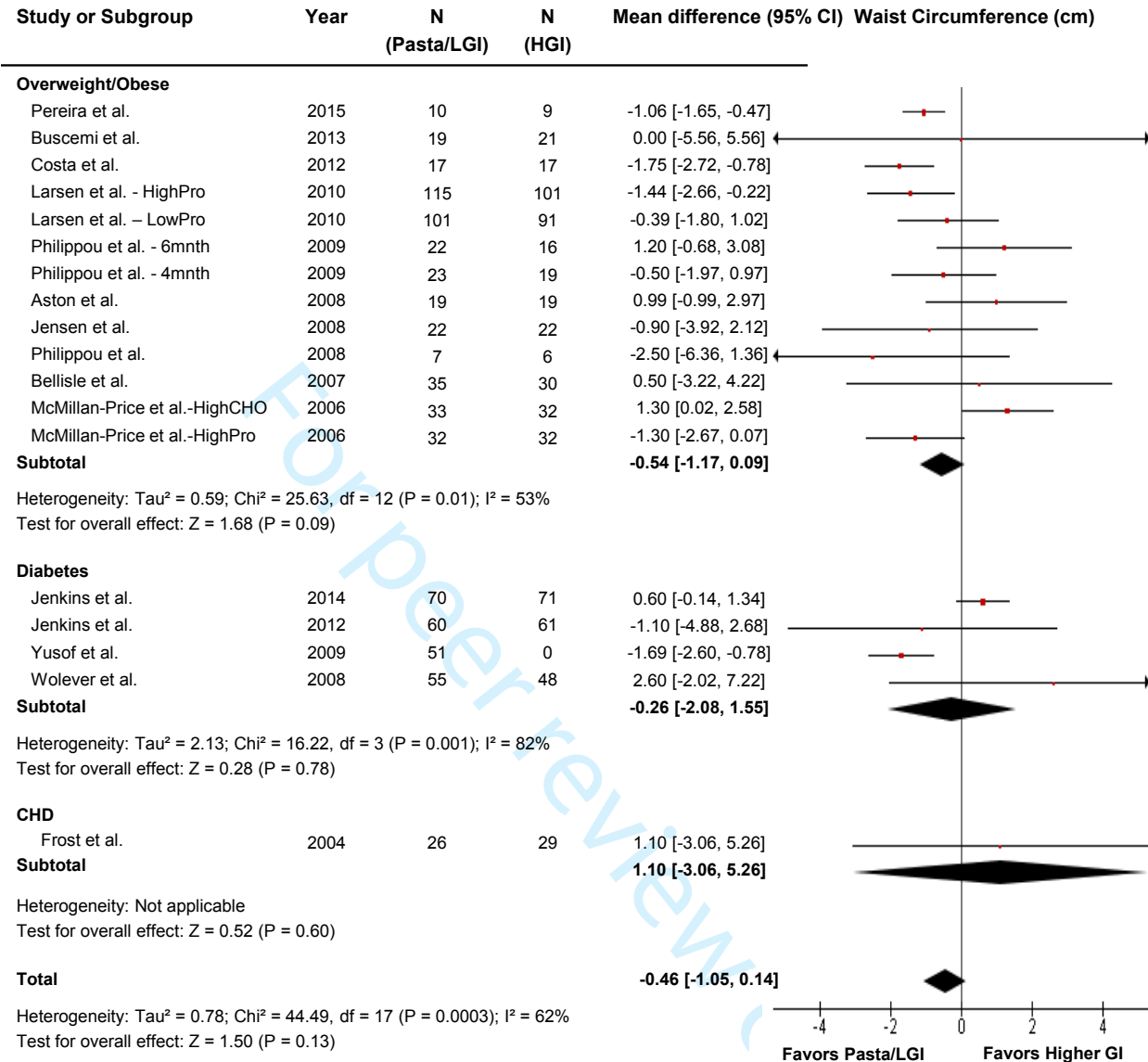
BMI, body mass index; CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S4: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body fat (%) (n= 285)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

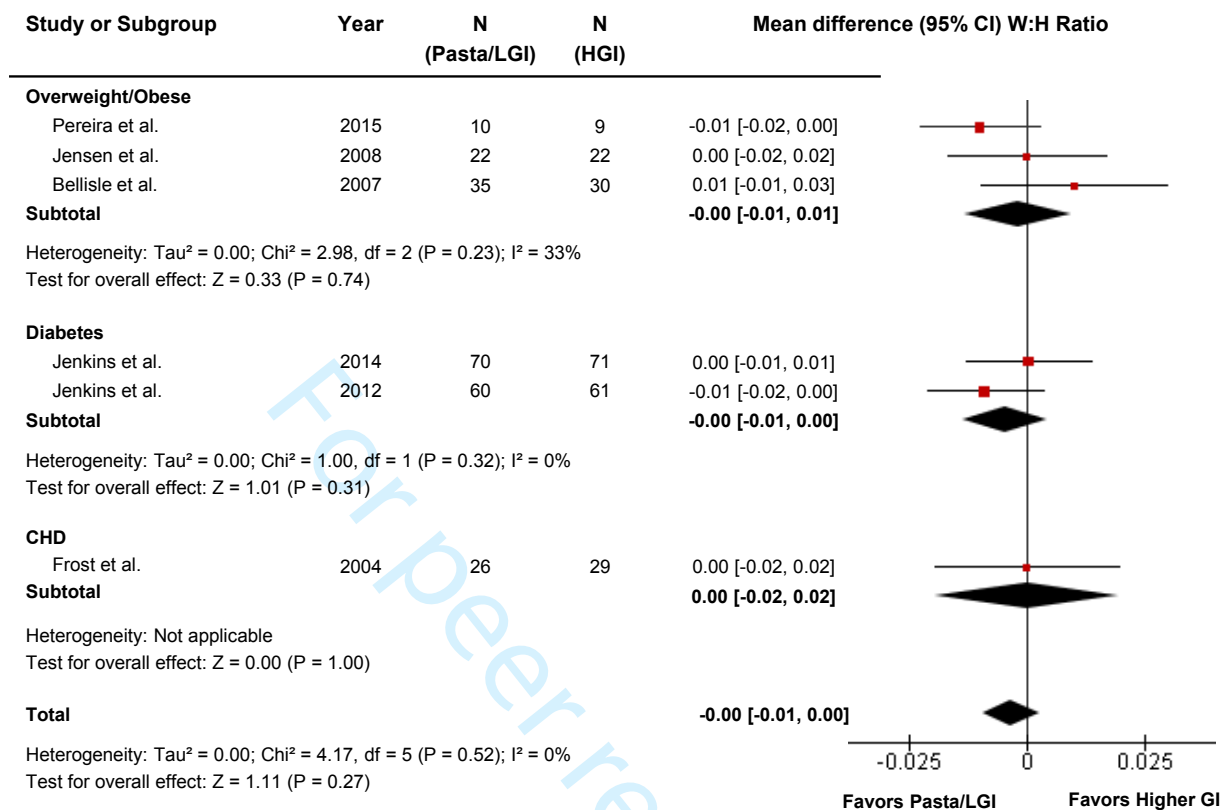
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S5: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot’s bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran’s Q statistic at a significance level of P<0.10 and quantified with the use of the I² statistic where I²≥50% is considered to be evidence of substantial heterogeneity and ≥75% considerable heterogeneity.

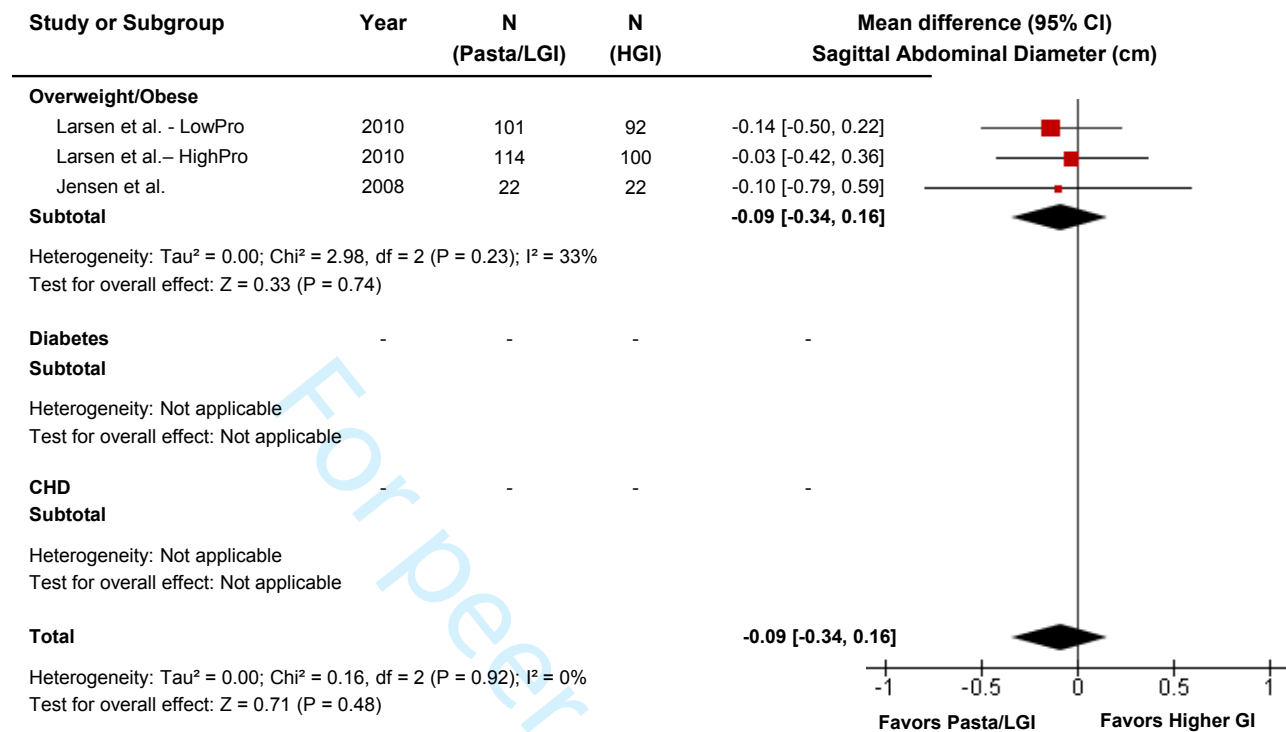
CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; Pro, protein



Supplemental Figure S6: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on waist-to-hip ratio (n = 445)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

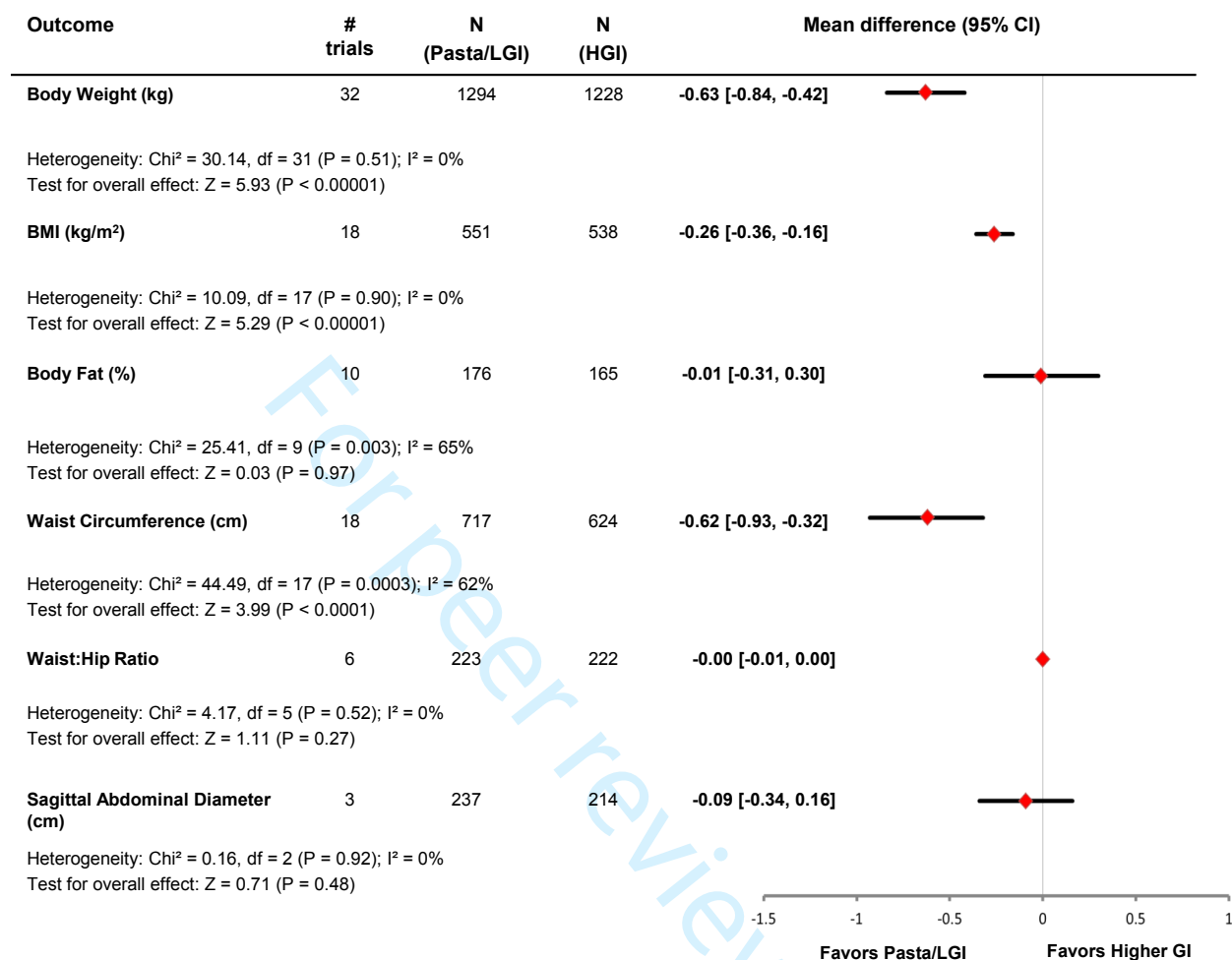
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet



Supplemental Figure S7: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on sagittal abdominal diameter (cm) (n = 478)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

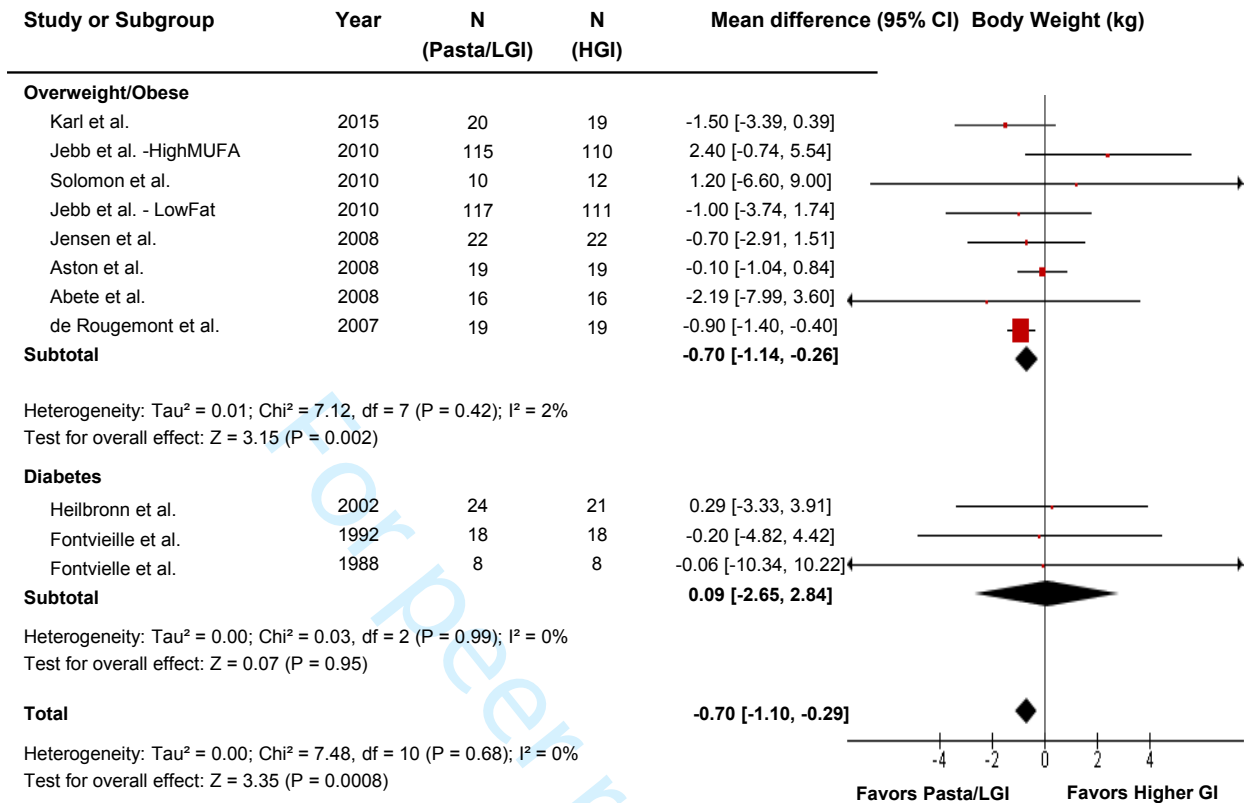
CHD, coronary heart disease; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; Pro, protein



Supplemental Figure S8: Forest plot of randomized controlled trials investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg) using fixed effects models (n = 2448)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance fixed effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

CHD, coronary heart disease; CHO, carbohydrate; CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids; Pro, protein.

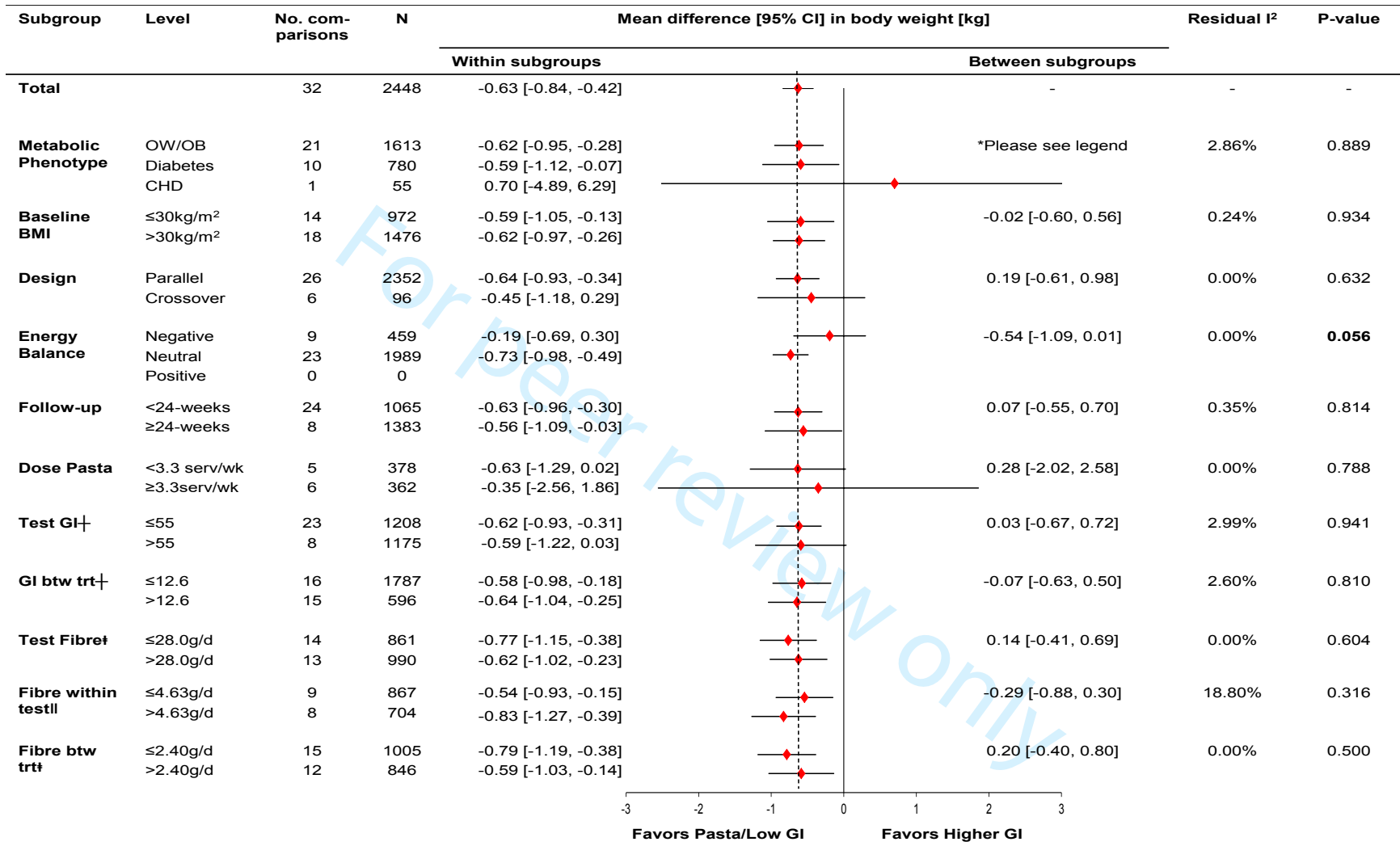


Supplemental Figure S9: Forest plot of randomized controlled trials which contain data for approximating pasta intake which are investigating the effects of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 740)

Data are expressed as mean differences represented by a square and 95% CIs by the line through the square. 95% CIs exceeding the plot's bounds are represented by an arrowhead. Pooled effect estimates are represented by diamonds and were estimated with the use of generic inverse variance random effects models. Between-study heterogeneity was detected with the use of the Cochran's Q statistic at a significance level of $P < 0.10$ and quantified with the use of the I^2 statistic where $I^2 \geq 50\%$ is considered to be evidence of substantial heterogeneity and $\geq 75\%$ considerable heterogeneity.

CI, confidence interval; HGI, higher glycemic index diet; GI, glycemic index; LGI, low glycemic index diet; MUFA, monounsaturated fatty acids

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Supplemental Figure S10: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes.
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11 BMI, body mass index; btw, between; CHD, coronary heart disease; CI, confidence interval; GI, glycemic index (glucose scale); OB,
12 obese; OW, overweight; serv, serving; trt, treatment; wk, week.
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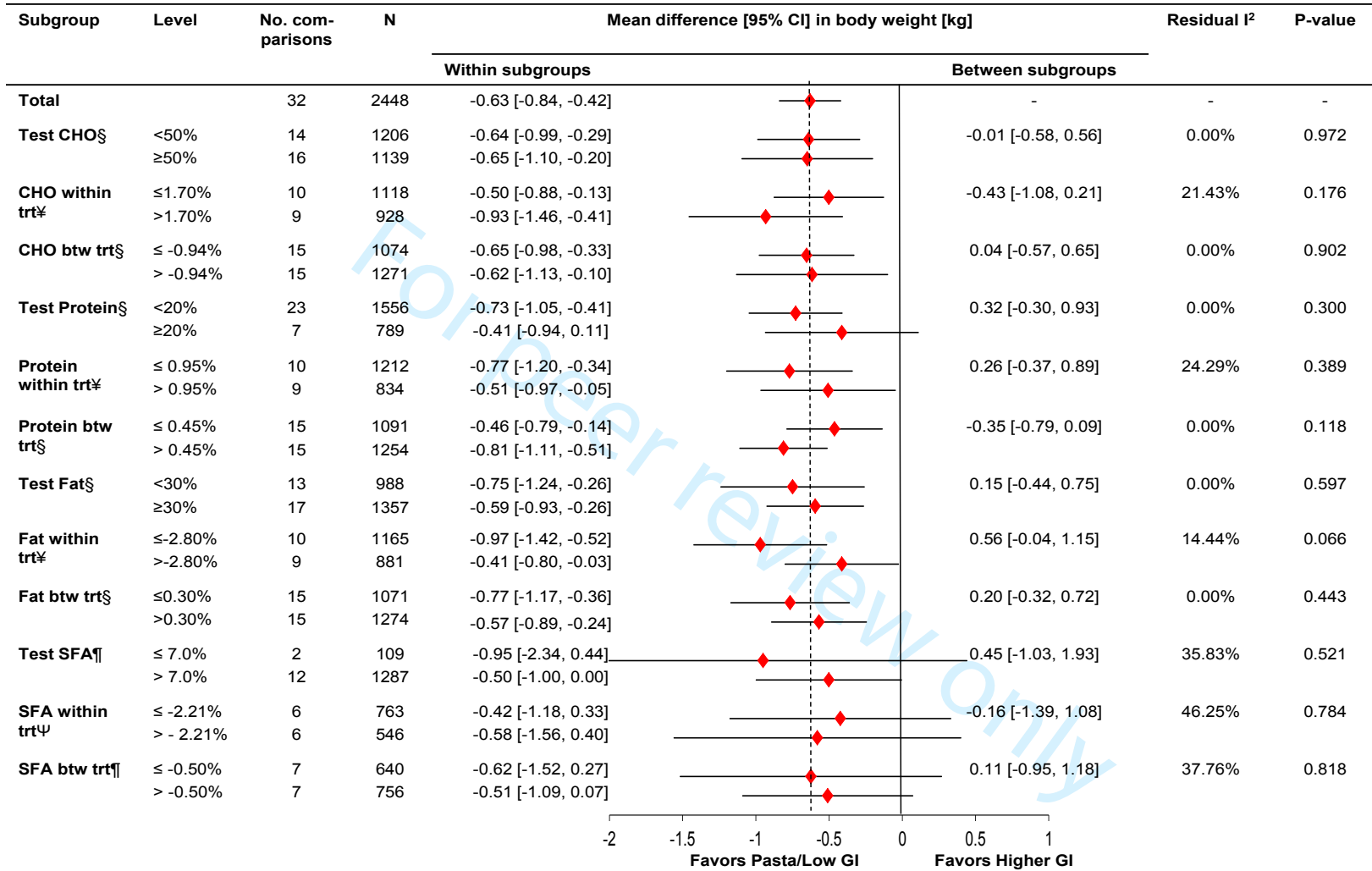
14
15 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.02kg (-0.08, 0.65) (1 vs. 2) to
16 1.32kg (-4.28, 6.91) (1 vs. 3) to -1.29kg (-6.91, 4.32) (2 vs. 3).

17 † data available on 31 studies

18 ‖ data available on 17 studies

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Supplemental Figure S11: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body weight (kg) continued (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes.
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11 BMI, body mass index; btw, between; CI, confidence interval; GI, glycemic index (glucose scale); trt, treatment.

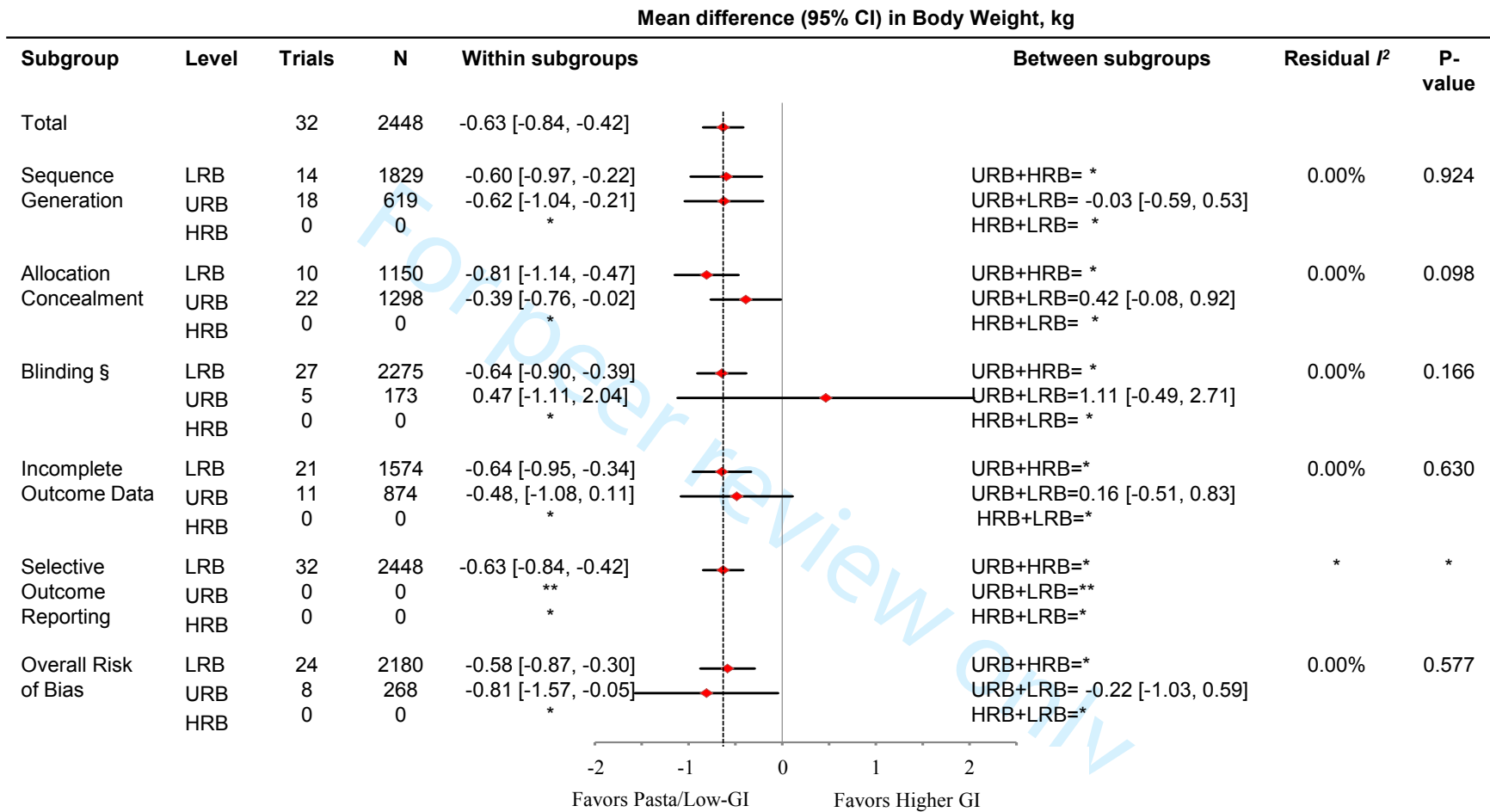
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14 ¶ data available on 14 studies

15 Ψ data available on 12 studies
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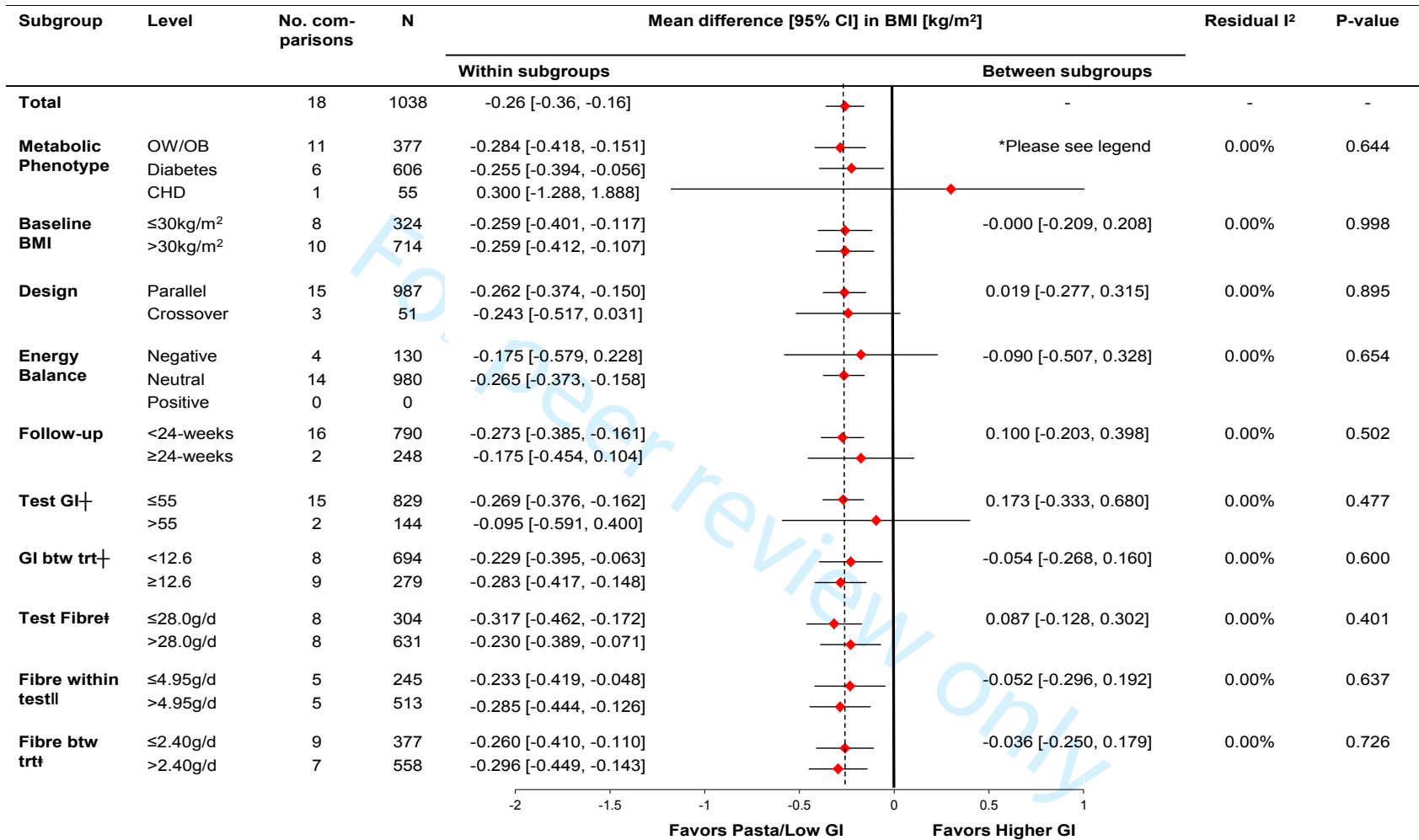


Supplemental Figure S12: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body weight (kg) (n = 2448)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body weight. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by
5 the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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10 LRB=Low Risk of Bias, URB= Unclear Risk of Bias, HRB=High Risk of Bias. *Within and between subgroup analysis could not be
11 performed against HRB since no values for HRB subgroup. ** no values for URB subgroup. § Blinding of Participants, Personnel,
12 and Outcome Assessors.
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Supplemental Figure S13: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) (n = 1038)

The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line through the square. The residual I² was estimated with the use of the Cochran’s Q statistic and indicates the between study

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3 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
4 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
5 median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=3 trials), therefore analyses
6 were not performed.
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9 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.059kg/m^2 (-0.156, 0.274) (1 vs.
10 2) to 0.584kg/m^2 (-1.009, 2.178) (1 vs. 3) to -0.525kg/m^2 (-2.122, 1.072) (2 vs. 3).
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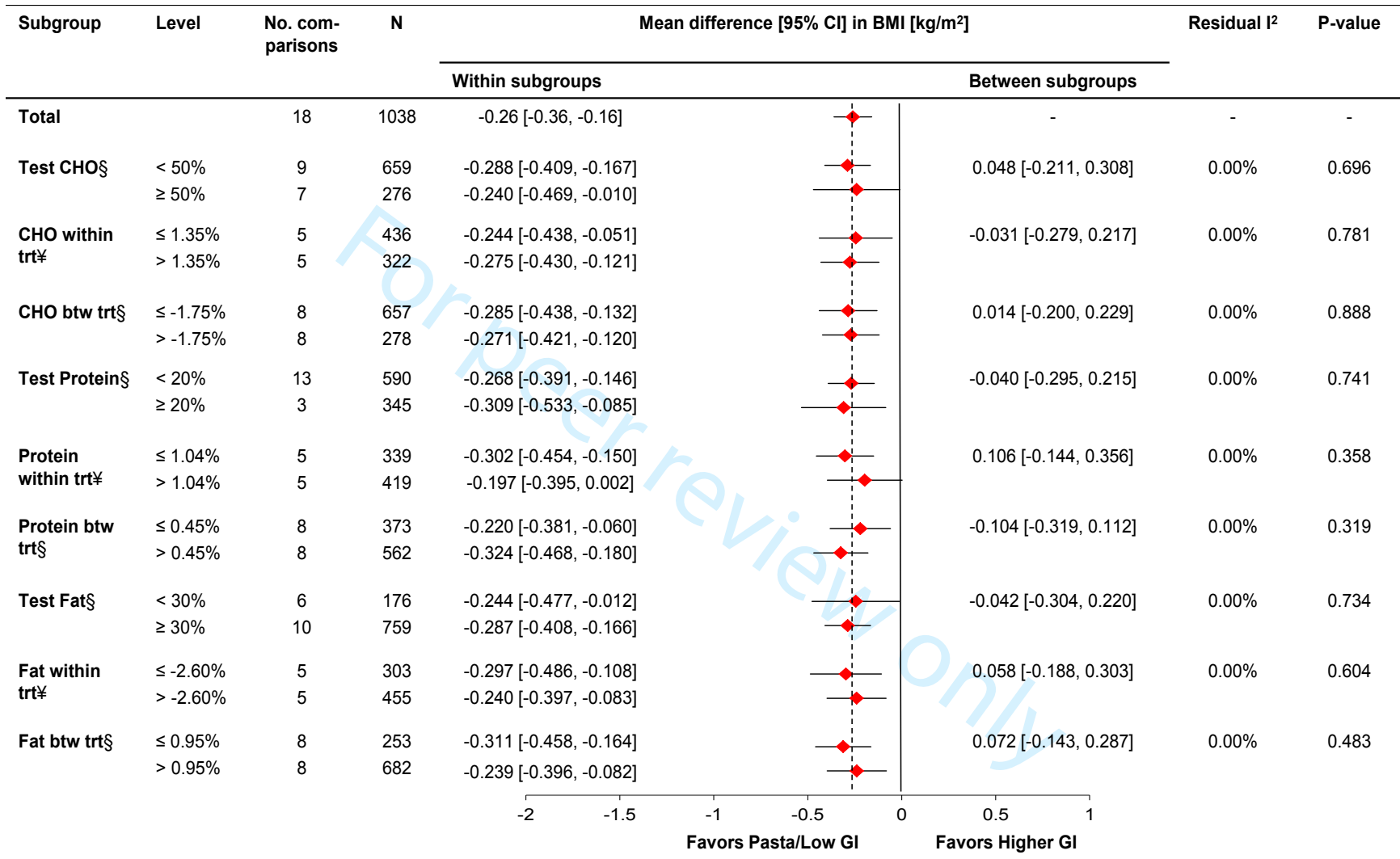
12 † data available on 17 studies

13 ‡ data available on 16 studies

14 § data available on 10 studies
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16 BMI, body mass index; btw, between; CI, confidence interval; GI, glycemic index (glucose scale); OB, obese; OW, overweight; trt,
17 treatment.
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Supplemental Figure S14: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) continued (n = 1038)

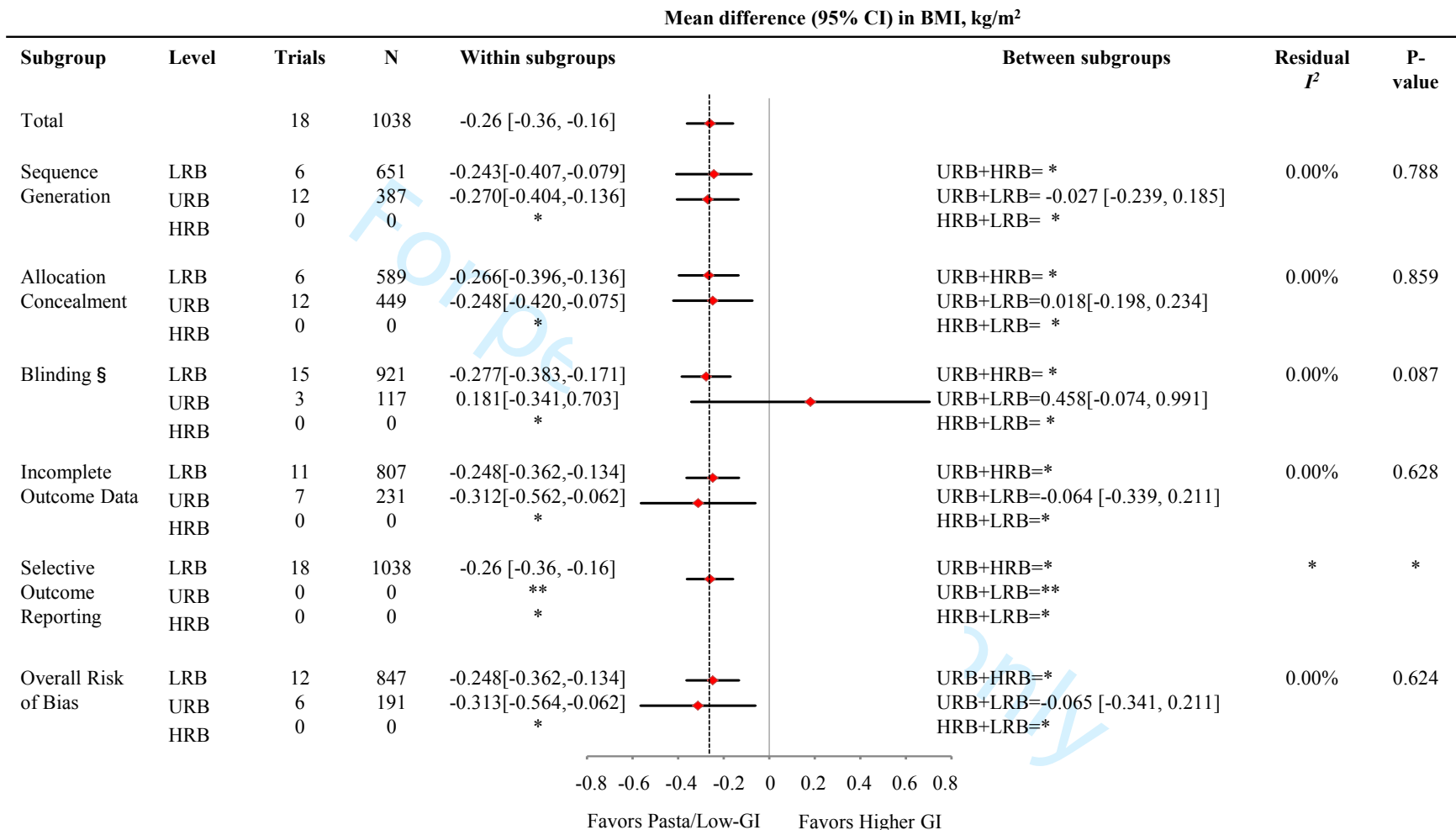
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line
5 through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes. There were less than 10 trials available for categorical subgroup assessment for test saturated fat (n=7 trials), saturated
9 fat within treatment (n=6 trials) and saturated fat between treatments (n=7 trials), therefore analyses were not performed.

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11 § data available on 16 studies

12 ¥ data available on 10 studies
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15 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); trt, treatment.
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Supplemental Figure S15: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body mass index, BMI (kg/m²) (n = 1038)

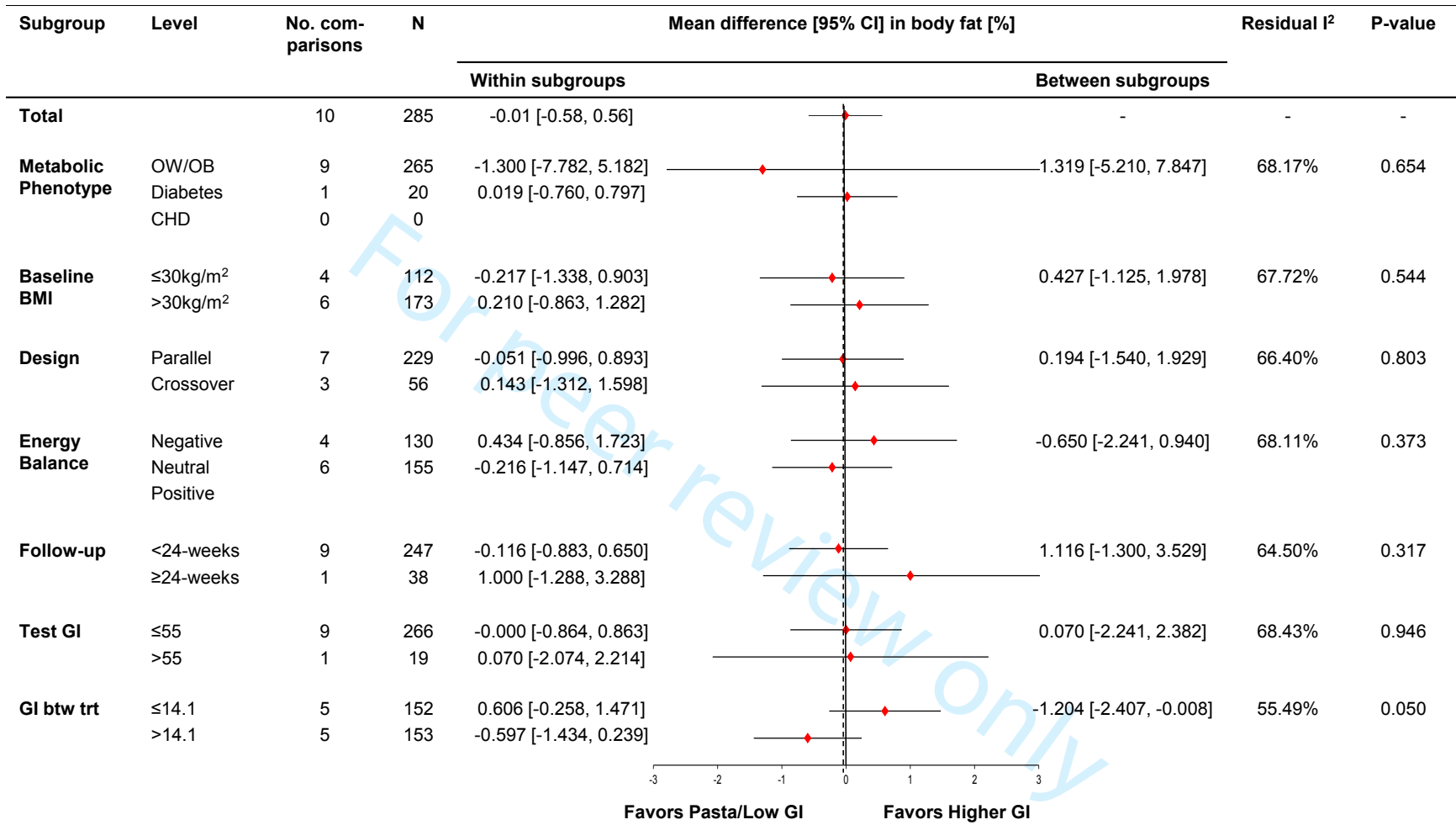
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 BMI. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the line
5 through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.

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15 BMI, body mass index; CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear
16 Risk of Bias.
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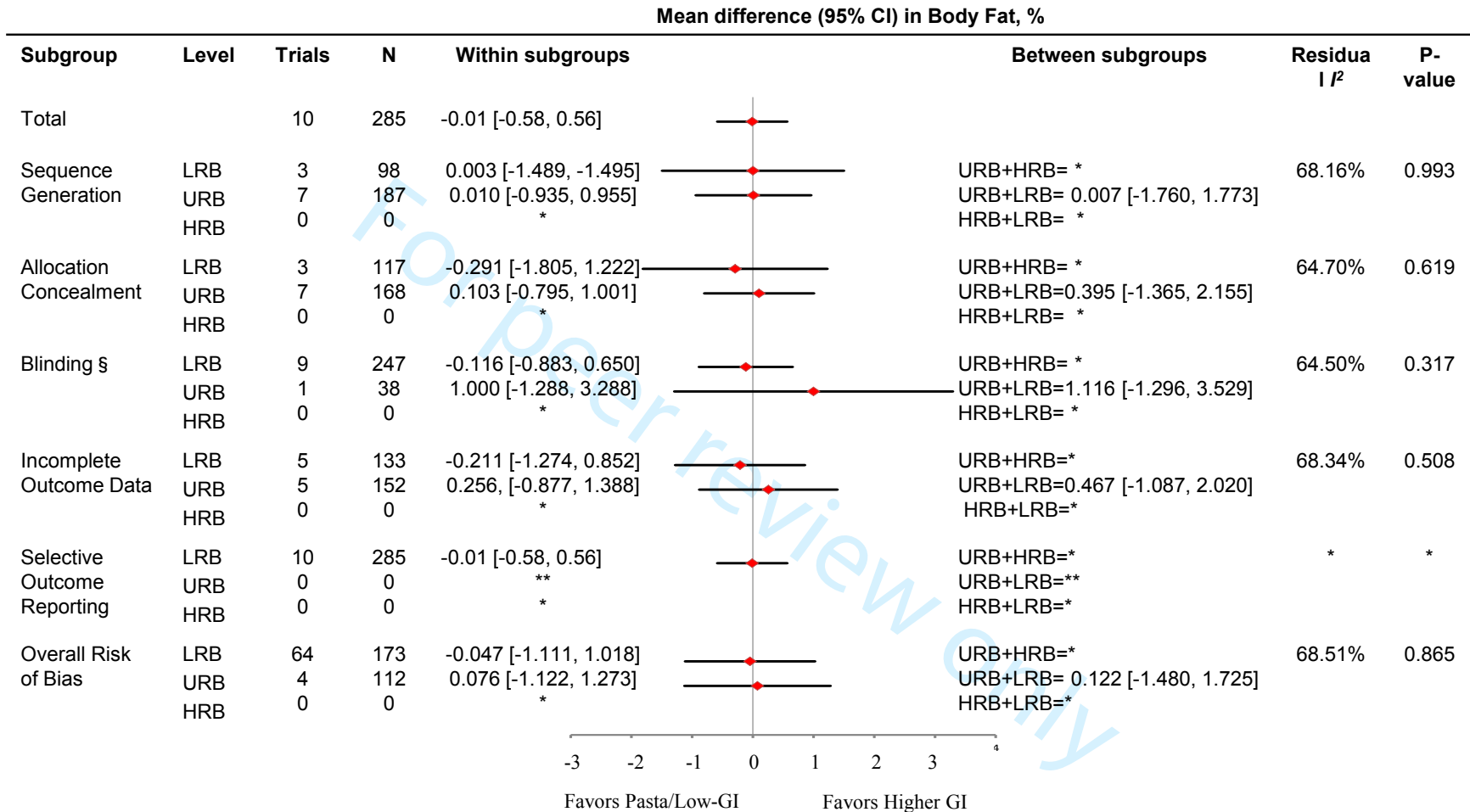


Supplemental Figure S16: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on body fat (%) (n = 285)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body fat. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the
5 line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup. Within and between-treatment changes were categorically assessed based on the
8 median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=3), test carbohydrate, protein
9 and fat (n=9), carbohydrate, protein and fat within treatment (n=4), carbohydrate, protein and fat between treatment (n=9), test fibre
10 (n=8), fibre within treatment (n=4), fibre between treatment (n=8), test saturated fat (n=3 trials), saturated fat within treatment (n=2
11 trials) and saturated fat between treatments (n=3 trials), therefore analyses were not performed.
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16 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); OB, obese;
17 OW, overweight; trt, treatment.
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Supplemental Figure S17: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on body fat (%) (n = 285)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 body fat. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are represented by the
5 line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the between study
6 heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$ indicated that the
7 effect size differed between levels of the subgroup.
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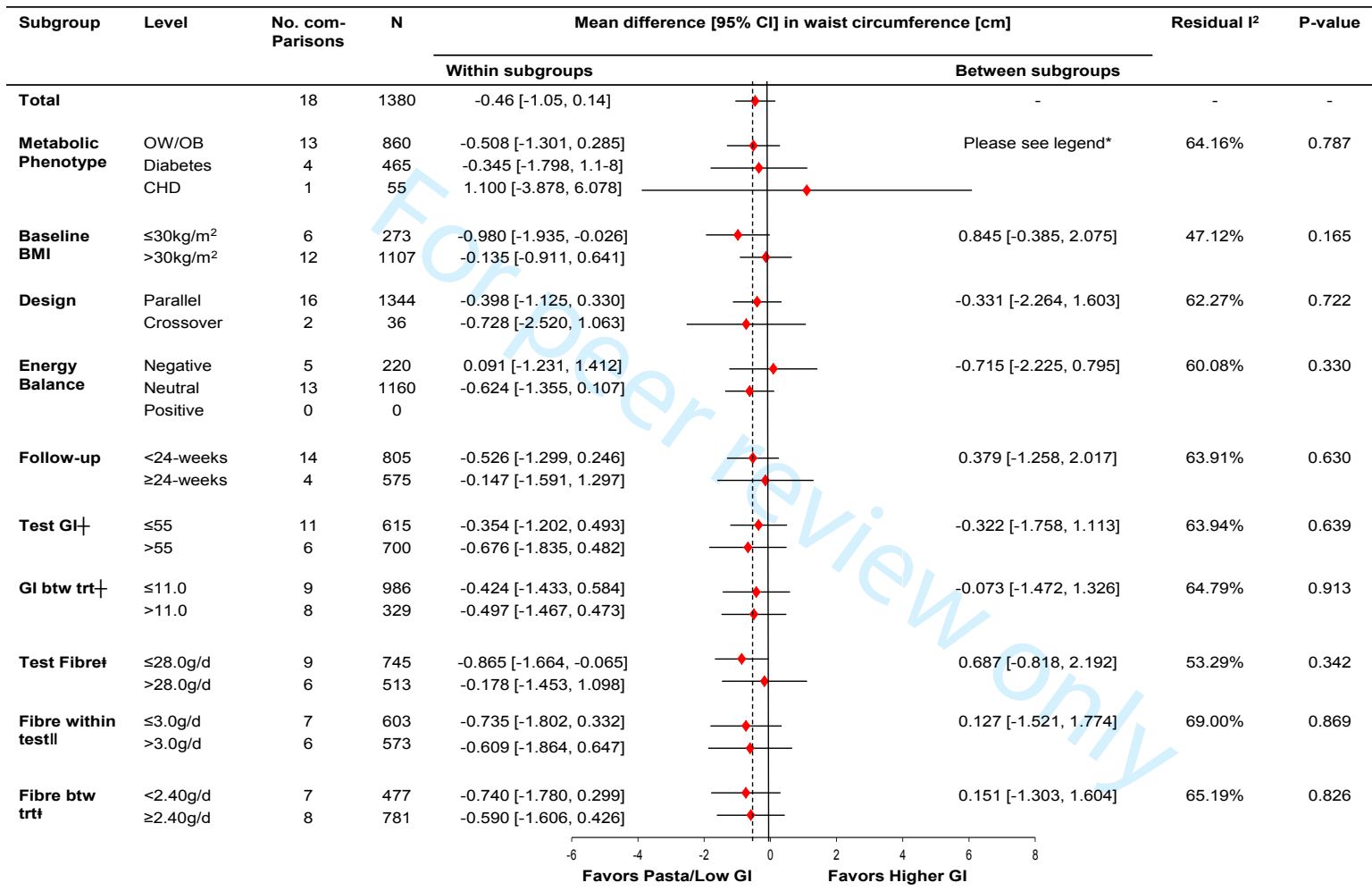
10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.
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15 CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear Risk of Bias
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Supplemental Figure S18: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup. Within and between-treatment changes were categorically
8 assessed based on the median intakes. There were less than 10 trials available for categorical subgroup assessment for dose (n=2
9 trials), therefore analyses were not performed.
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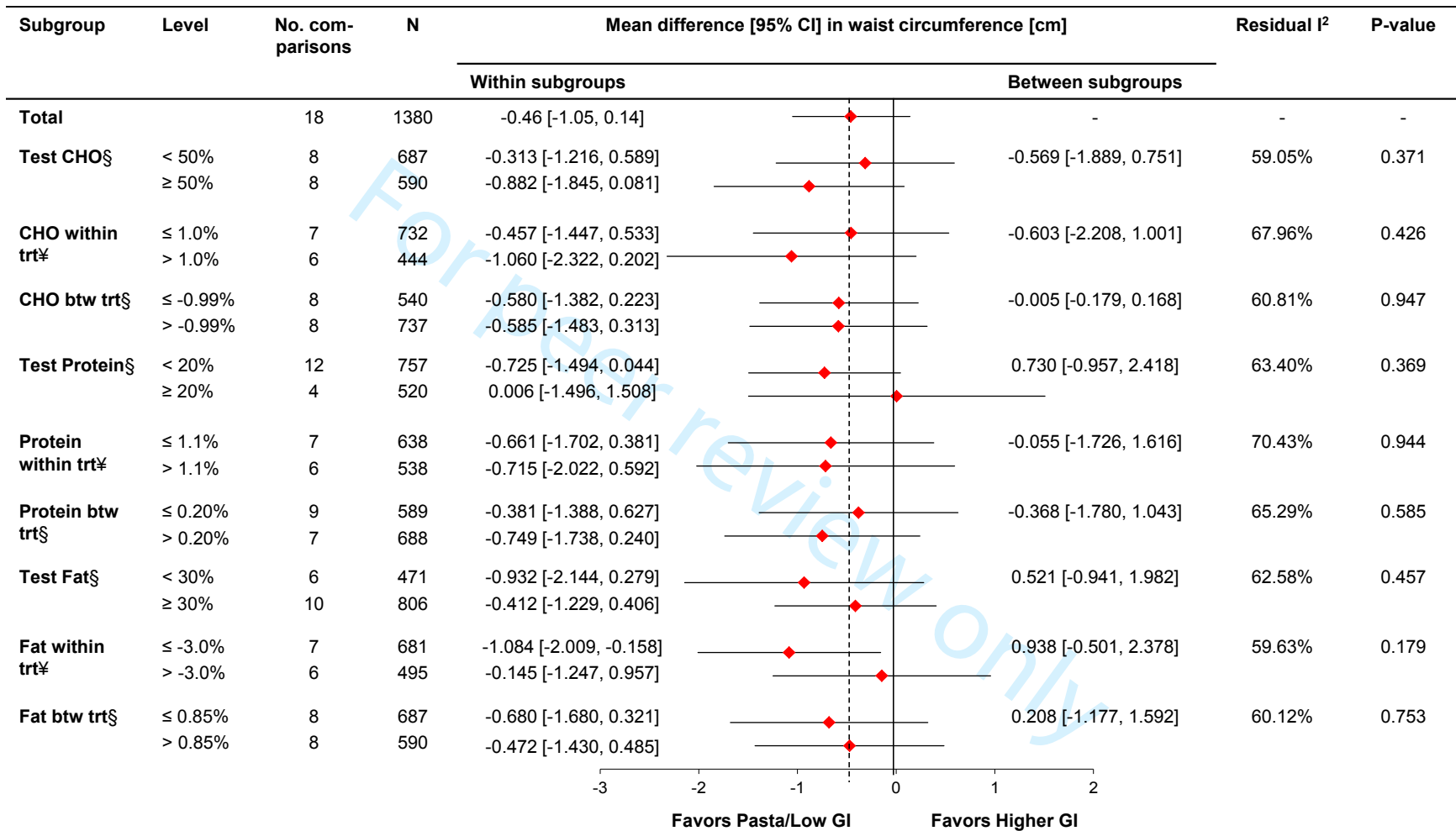
12 *Pairwise between-subgroup mean differences (95% CIs) for Metabolic Phenotype were as follows: 0.163cm (-1.492, 1.818) (1 vs. 2)
13 to 1.608cm (-3.432, 6.648) (1 vs. 3) to -1.445cm (-6.630, 3.740) (2 vs. 3).

14 † data available on 17 studies

15 ‡ data available on 15 studies
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18 BMI, body mass index; btw, between; CI = confidence interval; GI, glycemic index (glucose scale); OB, obese; OW, overweight; trt,
19 treatment.
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Supplemental Figure S19: Subgroup analysis for mean differences (95% CIs) of the effects of pasta in the context of low-GI dietary patterns on waist circumference (cm) continued (n = 1380)

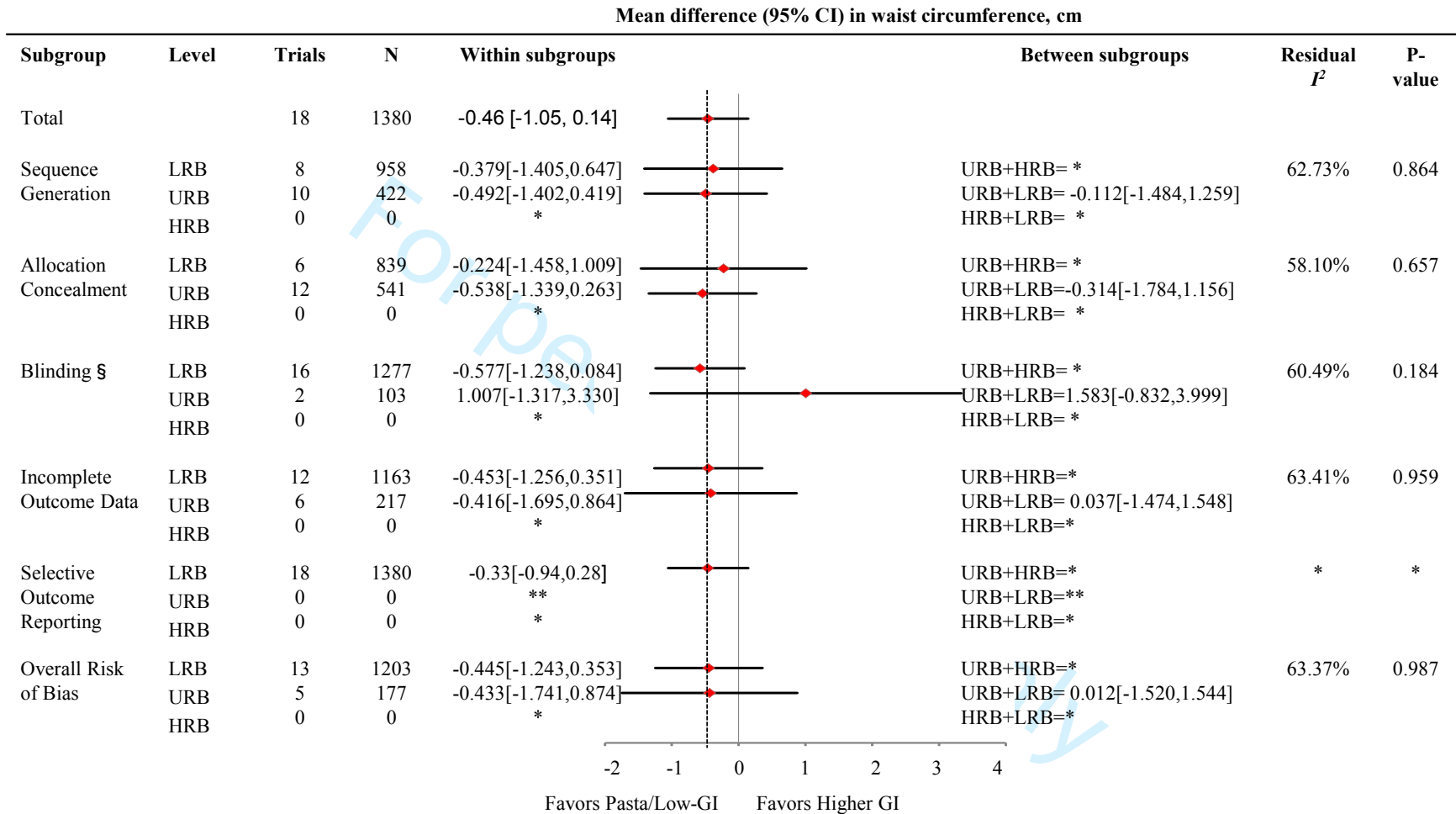
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup. Within and between-treatment changes were categorically
8 assessed based on the median intakes. There were less than 10 trials available for categorical subgroup assessment for test saturated fat
9 (n=8 trials), saturated fat within treatment (n=7 trials) and saturated fat between treatments (n=8 trials), therefore analyses were not
10 performed.
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13 § data available on 16 studies

14 ¥ data available on 13 studies

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17 BMI, body mass index; btw, between; CHO, carbohydrate; CI = confidence interval; GI, glycemic index (glucose scale); trt, treatment.
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Supplemental Figure S20: A priori subgroup analyses on risk of bias for mean differences (95% CIs) of the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm) (n = 1380)

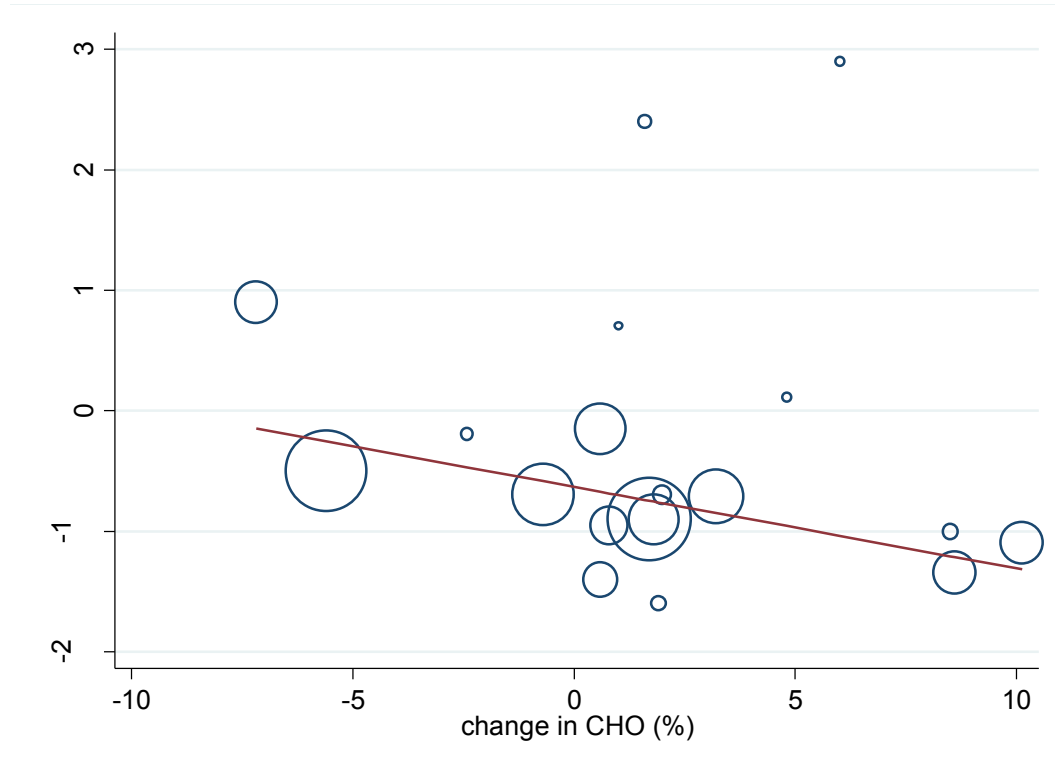
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3 The dashed line represents the pooled estimate for the overall primary analysis of pasta in the context of low-GI dietary patterns on
4 waist circumference. Within subgroup mean differences are the pooled effect estimates represented by a diamond. 95% CIs are
5 represented by the line through the square. The residual I^2 was estimated with the use of the Cochran's Q statistic and indicates the
6 between study heterogeneity unexplained by the variability in response because of the specific between studies factor. $P < 0.05$
7 indicated that the effect size differed between levels of the subgroup.
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10 *Within and between subgroup analyses could not be performed against HRB since no values for HRB subgroup.

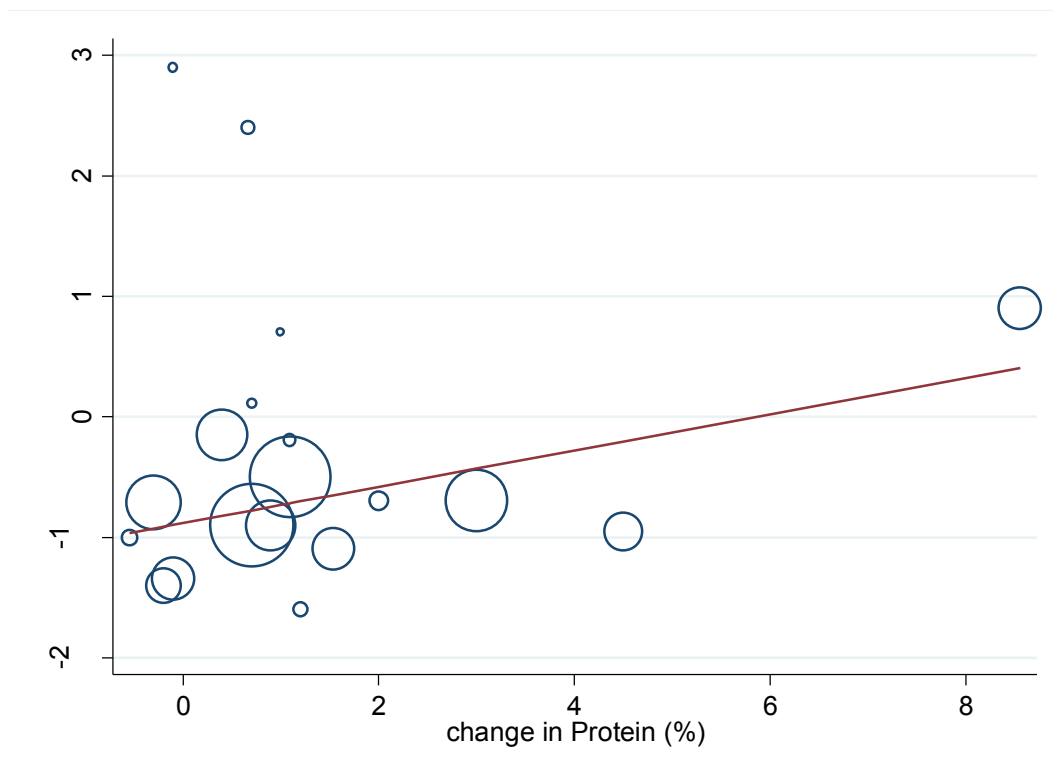
11 ** no values for URB subgroup.

12 § Blinding of Participants, Personnel, and Outcome Assessors.

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15 CI, confidence interval; HRB, High Risk of Bias; GI, glycemic index; LRB, Low Risk of Bias; URB, Unclear Risk of Bias
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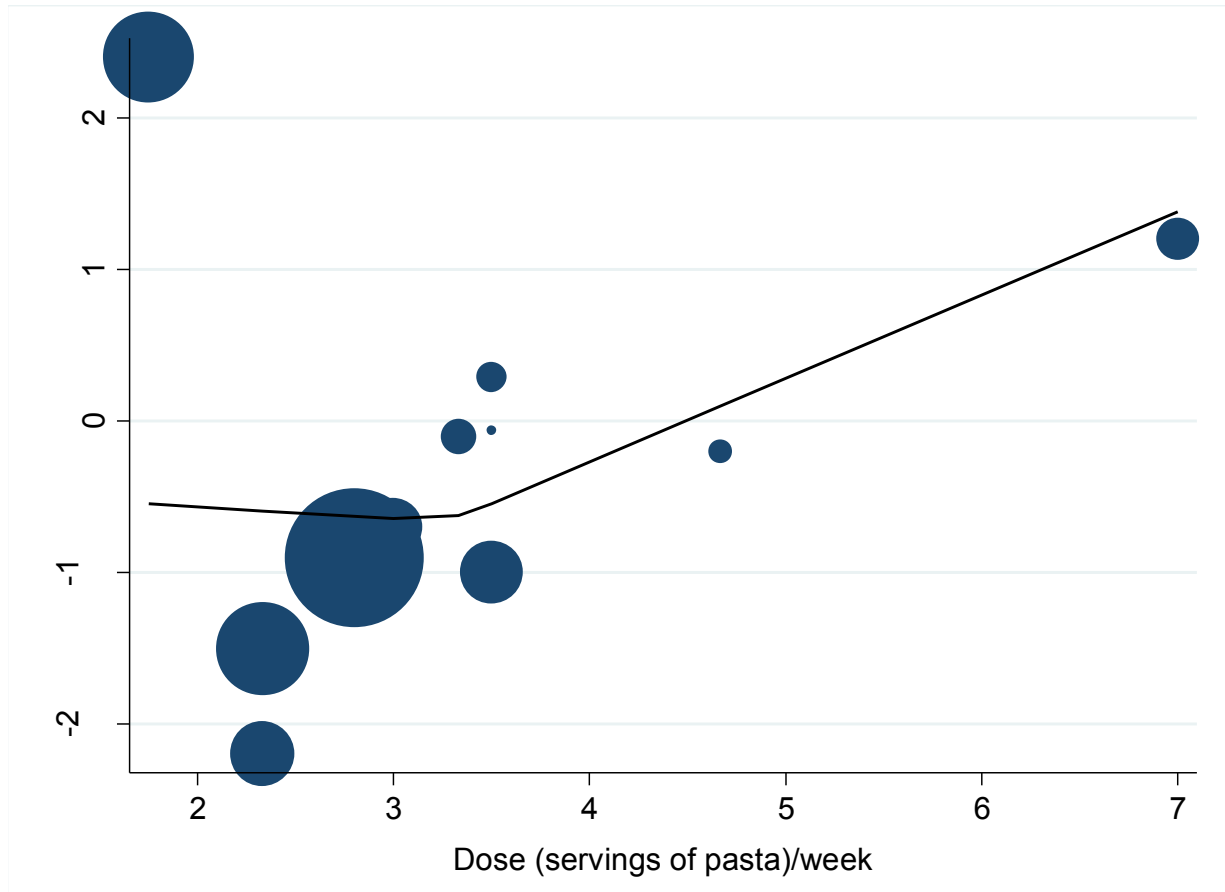


Supplemental Figure S21: Continuous meta-regression of change in carbohydrate intake in the low-GI dietary pattern intervention arms with change in body weight (n=19)
CHO, carbohydrate; MD, mean difference



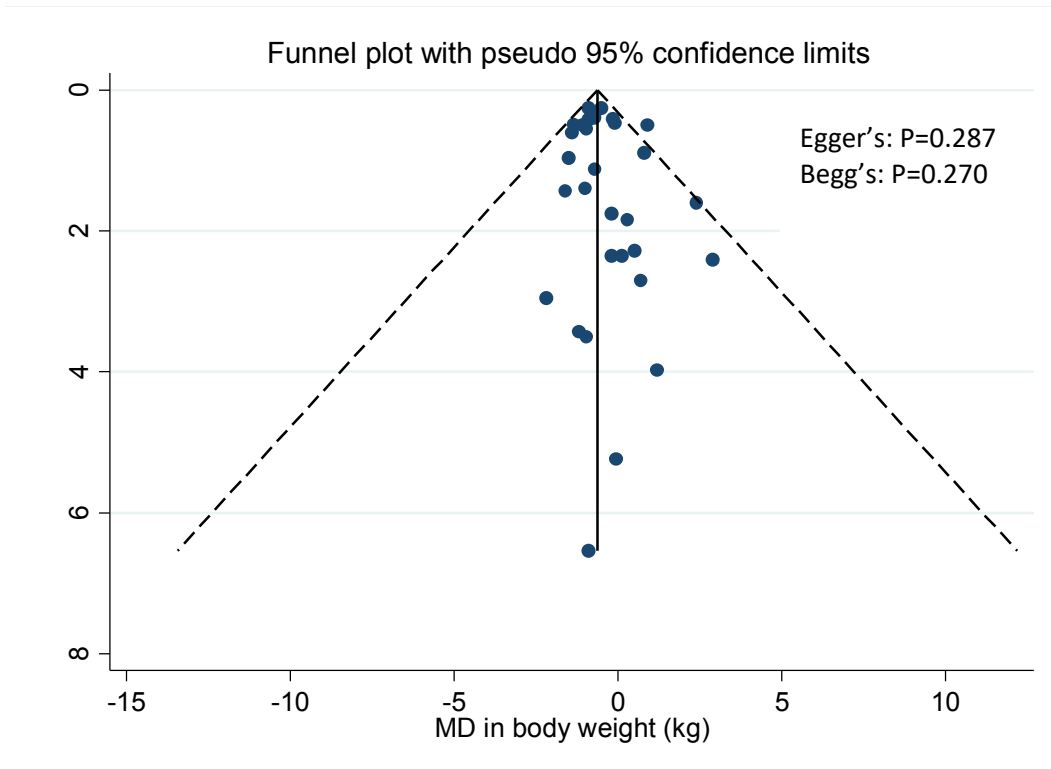
Supplemental Figure S22: Continuous meta-regression of change in protein intake in the low-GI dietary pattern intervention arms with change in body weight (n=19)
 MD, mean difference

review only



Supplemental Figure S23: Pasta intake dose-response analyses by spline curve modeling (MKSPLINE procedure)

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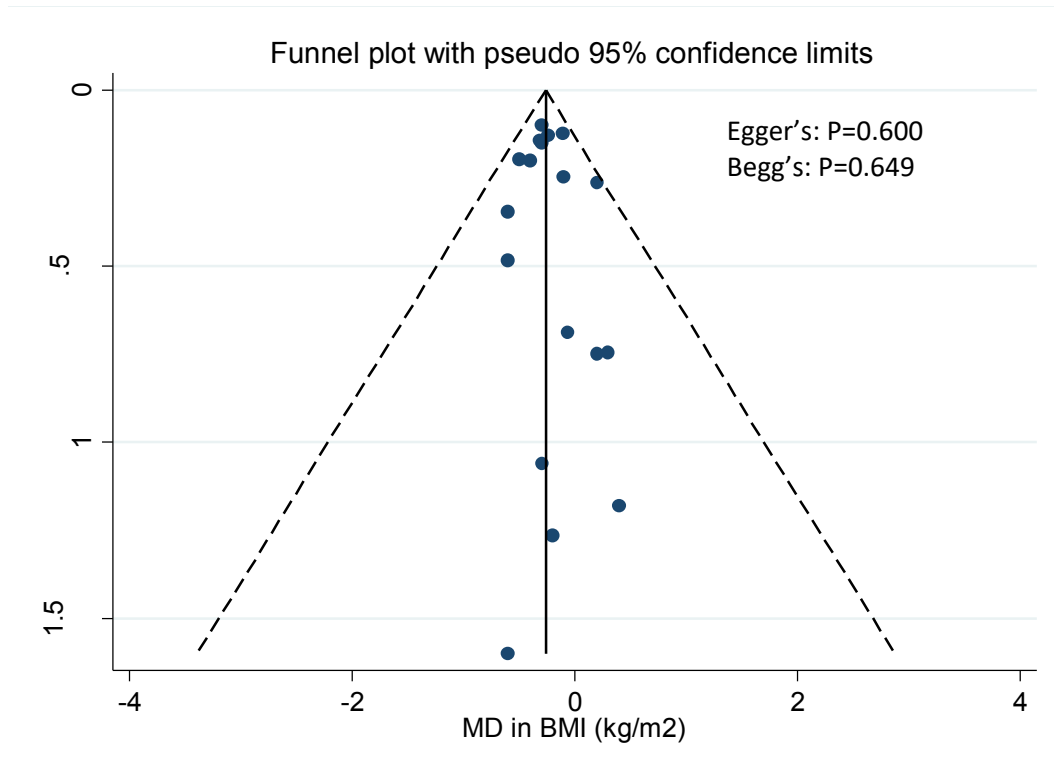


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Supplemental Figure S24: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on body weight (kg)

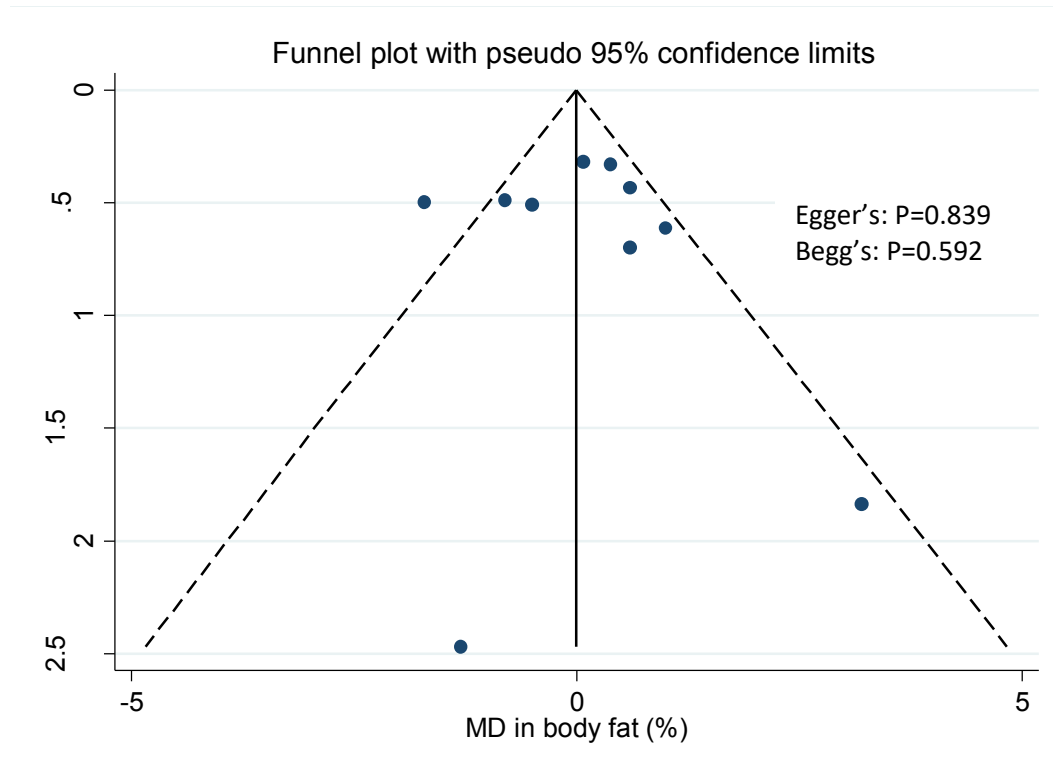
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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.



29 **Supplemental Figure S25: Funnel plot for the effect of pasta in the context of low-GI**
30 **dietary patterns on BMI (kg/m²)**

31 The solid line represents the overall pooled estimate for all studies included in the meta-analysis
32 expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived
33 from the quantitative assessment of publication bias by Egger's and Begg's tests.
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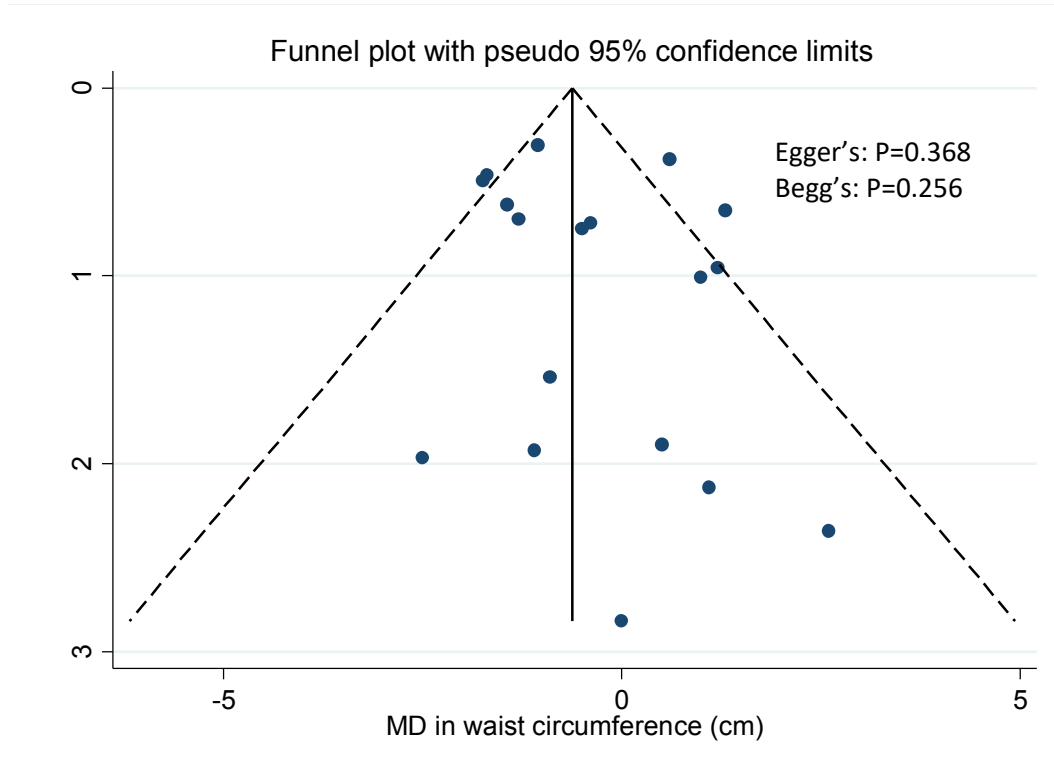


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Supplemental Figure S26: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on body fat (%)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.



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Supplemental Figure S27: Funnel plot for the effect of pasta in the context of low-GI dietary patterns on waist circumference (cm)

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The solid line represents the overall pooled estimate for all studies included in the meta-analysis expressed as a weighted mean difference. Dashed lines represent 95% CIs. P values are derived from the quantitative assessment of publication bias by Egger's and Begg's tests.

Supplemental Table S1: PRISMA Checklist



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5-6, Supplemental Table S2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5, Supplemental Table S1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supplemental Table S1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5-6, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and	6, Supplemental

		simplifications made.	Table S2
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6-7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7-8
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7-10
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	10, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-11, Table 1, Supplemental Tables S2-S3
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	11, Supplemental Figures S1-S2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11-13, Figures 2-3, Supplemental Figures S3-S7
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	11-13, Figures 2-3, Supplemental Figures S3-S7
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15).	11,15 Supplemental

			Table S1, S2, S12, S15, S17, S20
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	12-16, Supplemental Tables S4-S10, Supplemental Figures S8-S26
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16-22
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	19-21
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	22-23
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	26-31

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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