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Fruit and vegetable consumption and the risk of type 2 diabetes: a systematic review and dose–response meta-analysis of prospective studies

Rine Elise Halvorsen,[1] Mathilde Elvestad ,[1] Marianne Molin,[1,2] Dagfinn Aune[2,3,4,5]

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For numbered affiliations see end of article.

Correspondence to
Dr Dagfinn Aune, Department of Epidemiology and Biostatistics, London, UK;
d.aune@imperial.ac.uk

REH and ME are joint first authors.

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ABSTRACT

Background The association between intake of fruit and vegetables and their subtypes, and the risk of type 2 diabetes has been investigated in several studies, but the results have been inconsistent.

Objective We conducted an updated systematic review and dose–response meta-analysis of prospective studies on intakes of fruit and vegetables and fruit and vegetable subtypes and the risk of type 2 diabetes.

Design PubMed and Embase databases were searched up to 20 October 2020. Prospective cohort studies of fruit and vegetable consumption and type 2 diabetes mellitus were included. Summary relative risks (RRs) and 95% CIs were estimated using a random effects model.

Results We included 23 cohort studies. The summary RR for high versus low intake and per 200 g/day were 0.93 (95% CI: 0.89 to 0.98, I^2=0%, n=10 studies) and 0.98 (95% CI: 0.95 to 1.01, I^2=37.8%, n=7) for fruit and vegetables combined, 0.93 (95% CI: 0.90 to 0.97, I^2=9.3%, n=20) and 0.96 (95% CI: 0.92 to 1.00, I^2=68.4%, n=19) for fruits and 0.95 (95% CI: 0.88 to 1.02, I^2=60.4%, n=17) and 0.97 (95% CI: 0.94 to 1.01, I^2=39.2%, n=16) for vegetables, respectively. Inverse associations were observed for apples, apples and pears, blueberries, grapefruit and grapes and raisins, while positive associations were observed for intakes of cantaloupe, fruit drinks, fruit juice, brussels sprouts, cauliflower and potatoes, however, most of these associations were based on few studies and need further investigation in additional studies.

Conclusions This meta-analysis found a weak inverse association between fruit and vegetable intake and type 2 diabetes risk. There is indication of both inverse and positive associations between intake of several fruit and vegetables subtypes and type 2 diabetes risk, however, further studies are needed before firm conclusions can be made.

What this paper adds

- In this systematic review and meta-analysis of 23 cohort studies we found that high vs. low intakes of fruit and vegetables combined and fruit were associated with a 7% reduction in risk of type 2 diabetes.
- There was suggestive evidence that intakes of apples, blueberries, grapefruit, grapes and raisins were associated with reduced type 2 diabetes risk, while positive associations were observed for intakes of fruit drinks, fruit juice, cantaloupe, potatoes, and some subtypes of cruciferous vegetables.
- Diets high in fruit and vegetables may be important for the prevention of type 2 diabetes and it may be important to emphasize specific subtypes to reduce risk.

INTRODUCTION

The prevalence of type 2 diabetes has increased rapidly over the past decades, and in 2019, approximately 463 million adults aged 20–79 years were living with diabetes. If current trends continue the prevalence is estimated to pass 700 million by 2045.[1] As type 2 diabetes contributes to blindness, neuropathies, nephropathies, cardiovascular disease, cancer and premature mortality,[2 3] the increasing prevalence has a considerable impact on public health globally.[4]

Although several studies have suggested that a high intake of fruit and vegetables is associated with a reduced risk of type 2 diabetes,[5–9] associations have often been weak or modest, and several other studies have found no clear association.[10–16] The evidence has been slightly more consistent in showing an inverse association between fruit intake and type 2 diabetes,[6–10 12–23] than for vegetables.[5 6 8 9 11 13–20 22–24] In addition, some studies have suggested that specific types of fruits and vegetables may be more strongly associated with reduced risk of type 2 diabetes than overall fruit and vegetable intake. Inverse associations have been observed between the intake of apples/pears,[10 25–27] berries,[5 6 8 25 27] green leafy vegetables,[8 9 11] yellow vegetables,[9 15] root vegetables[6] and tomatoes[9] and the risk of type 2 diabetes, however, the available data have not been entirely consistent. In contrast, studies on intakes of fruit juice and potatoes and type 2 diabetes risk have tended to show increased

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risk[8 21 28] or no association,[11 13 23 29] although one study reported an inverse association with intake of potatoes.[30]

While several meta-analyses have previously been published on fruit and vegetable intake and type 2 diabetes risk[6 11 31–35] most have only analysed a few specific fruit and vegetable subtypes.[6 11 23 33] For example, Cooper *et al* only considered green leafy vegetables and root vegetables,[6] Jia *et al* only considered citrus fruits and cruciferous vegetables,[36] Chen *et al* only considered green leafy and cruciferous vegetables[11] and Guo *et al* only considered apples and pears.[31] The most recent meta-analysis by Schwingshackl *et al* only investigated total fruit and total vegetable intake,[34] while a recent umbrella review found moderate evidence of a small inverse association for total fruits and for total vegetables, however, not all subtypes of fruits and vegetables were analysed.[37] Sixteen additional cohort studies[7 10–12 17–19 21 23 29 38–43] have been published since these meta-analyses came out, thus we conducted a comprehensive and up-to-date systematic review and meta-analysis of prospective observational studies on intakes of fruit and vegetable and subtypes of fruit and vegetables and the risk of developing type 2 diabetes.

METHODS

Search strategy

We conducted a systematic search of PubMed and Embase databases (without employing search filters) up to 20 October 2020 for eligible prospective cohort studies examining the association between the intake of fruit and vegetables and risk of type 2 diabetes. Two authors (REH and ME) screened the references in both databases independently. The search strategy used is shown in online supplemental table 1. The reference lists of retrieved articles were also scrutinised. There were no language restrictions.

Study selection

Studies were included if they had a prospective cohort, a case-cohort or a nested case–control design and investigated the association between the intake of fruit and/or vegetables, subtypes of fruit and vegetables, fruit juices and/or fruit drinks and risk of type 2 diabetes. The participants had to be free from type 2 diabetes at baseline. Multivariable adjusted risk estimates (relative risks (RRs), or ORs, HRs) with their corresponding 95% CIs had to be available in the publication. Intake levels for the different exposures, in addition to total number of cases and person-years, had to be available for the dose–response analyses.

If duplicate reports from the same study cohort were identified, the study with most cases was included. Both the EPIC-InterAct Study[6] and the European Prospective Investigation into Cancer and Nutrition (EPIC)-Elderly Greece Study[20] were included as Greece is not a part of the EPIC-InterAct Study. ME and REH conducted the literature screening and study selection in duplicate. The excluded studies are listed in online supplemental table 2.

Data extraction

The following data were extracted from each study: the first author's last name, publication year, geographic location, name of the study, recruitment and follow-up period, sample size, age, sex, number of cases, dietary assessment method including number of food items assessed and whether it has been validated, outcome assessment, exposure, quantity of the exposure, RRs and 95% CIs for the association, and confounders adjusted for in the analysis. We used the RR that reflected the greatest degree of adjustment for confounding variables. Data extraction was done by one of the authors (REH) and double-checked by a second author (ME). Three publications[21 43 44] included data from multiple cohorts and results from each cohort were used rather than the pooled results. Standard criteria for the reporting of meta-analyses of observational studies, the MOOSE criteria and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement, were followed in this meta-analysis.[45 46]

Study quality assessment

Two authors (ME and REH) independently assessed all included studies using a modified version of the Newcastle-Ottawa Scale (NOS) to evaluate study quality,[47] which allowed a total score from 0 to 8 points, and we considered a total score of 0–3, >3–6 and >6–8 indicating low, medium and high study quality, respectively. The score was modified by (1) deleting the point about representability, which is not really relevant for study quality, (2) giving 0.25 points per confounder that was adjusted for, up to a maximum of 2 points, rather than 1 point for each of two confounders, as studies could have adjusted only for age and sex and still be given maximum score in spite of being prone to confounding and (3) by refining the scoring for the outcome assessment so that studies only using registry linkage scored 0.5 point and those with independent assessment/validated assessment scored 1 point.

Statistical methods

The random effects model by DerSimonian and Laird, which take into account heterogeneity within and between studies, was used to calculate summary RRs and 95% CIs for the association between fruit and vegetable intake and type 2 diabetes.[48] A two-tailed $p<0.05$ was considered statistically significant.

The method of Greenland and Longnecker was used for the linear dose–response analysis and study specific slopes (linear trends) and 95% CIs were computed from the natural logarithm of the RRs across categories of fruit and vegetable intake.[49] For studies that did not report the distribution of cases or person-years, this was estimated using the total number of cases or person-years. If studies reported fruit and vegetable intake in ranges and had missing data on median or mean intake for each category of intake, we calculated the average of the upper and lower boundaries of each category which was used as a midpoint

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in each category. In studies where the highest or lowest category was open ended, the open-ended interval length was assumed to be the same as the adjacent interval. Four studies[14 17 50 51] presented data separately for men and women, and a fixed effects model was used to pool the results in order to obtain an overall risk estimate for men and women combined in these studies. For the China Kadoorie Biobank Study by Du *et al*,[7] we estimated missing 95% CIs by using the formula log(RR)±1.96 × SE before transforming the numbers back to non-logarithmic scale. In studies where serving size was specified, this was used. Otherwise, in accordance with other meta-analyses, we used a serving size of 80 g for fruit and vegetable intake,[6 34] and 250 mL for fruit juice and fruit drinks.[32] For subtypes of fruit and vegetables we used serving sizes based on the pooled analysis by Lee *et al*[41] (online supplemental table 3). We contacted the authors of two studies[22 30] to obtain missing information on cut-off values or median intake on different exposures, CIs and adjustments, and received detailed information from one author.[22] The other study[30] was excluded. We additionally obtained data on intake of berries overall (results for specific types of berries were reported in the original paper) from one study.[21]

Non-linear dose–response analyses were conducted using restricted cubic splines with three knots at 10%, 50% and 90% centiles of the distribution, which were then combined using multivariable meta-analysis.[52 53] Heterogeneity between studies was evaluated with Q and I^2 statistics,[54] ranging from 0% to 100%. Subgroup and meta-regression analyses stratified by study characteristics were conducted for fruit and vegetable exposures with at least eight studies in the analysis. Subgroup analyses were conducted stratified by duration of follow-up, gender, geographical location, number of cases, study quality and adjustment for confounding factors to investigate sources of heterogeneity. Publication bias was assessed using Egger's test[55] and funnel plots were inspected for asymmetry when there were at least eight studies in the analysis. A p≤0.1 indicated presence of publication bias. When there was evidence of publication bias, we explored whether this was driven by one or a few outlying studies and conducted sensitivity analyses excluding such studies to see if the test for publication bias was attenuated, and also whether the summary estimate was altered. We also considered using the trim-and-fill method,[56] however, no studies were added to the analyses when using this method and thus we only report results from the previously mentioned sensitivity analyses. The robustness of the findings was tested in sensitivity analyses excluding one study at a time from the meta-analysis to clarify whether the results were driven by one very large study or a study with an extreme result. The statistical analyses were conducted using the software package Stata, V.15.1 (StataCorp).

RESULTS

The literature search resulted in a total of 18 088 records with 10 337 records in PubMed, and 7750 records in Embase and one record identified from a separate search. The process of the study selection is shown in figure 1. A total of 17 526 records were excluded because they were irrelevant based on inspection of title or abstract. Full texts of 562 potentially eligible studies were assessed in detail and out of these a total of 42 publications[5–26 29 38–40 42–44 50 51 57–67] with data from 23 cohort studies were included in the meta-analysis. Online supplemental table 4 shows the characteristics extracted from the included studies. The follow-up periods ranged from 4 to 30 years. Ten studies were from America, five from Europe, five from Asia and three from Australia. The mean (median) study quality scores were 6.8 (7.0) when evaluated with the modified NOS (online supplemental table 5). Online supplemental figures 1-90 shows the high versus low, linear and non-linear dose–response analyses of fruit and vegetable subtypes and the risk of type 2 diabetes, while online supplemental figures 91-100 shows the influence analyses and online supplemental figures 101-106 shows the funnel plots.

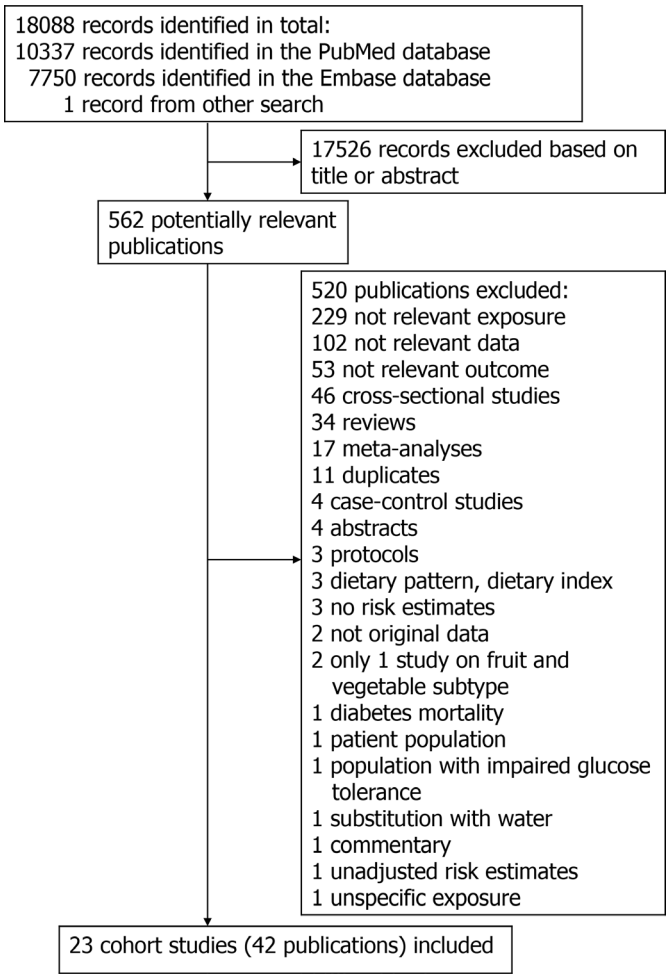

Figure 1 Flow chart of study selection.

Fruit and vegetables

A total of 10 cohort studies (10 publications)[5 6 14–17 22 42 58 60] (29 768 cases, 729 478 participants) investigated the association between total fruit and vegetable intake and type

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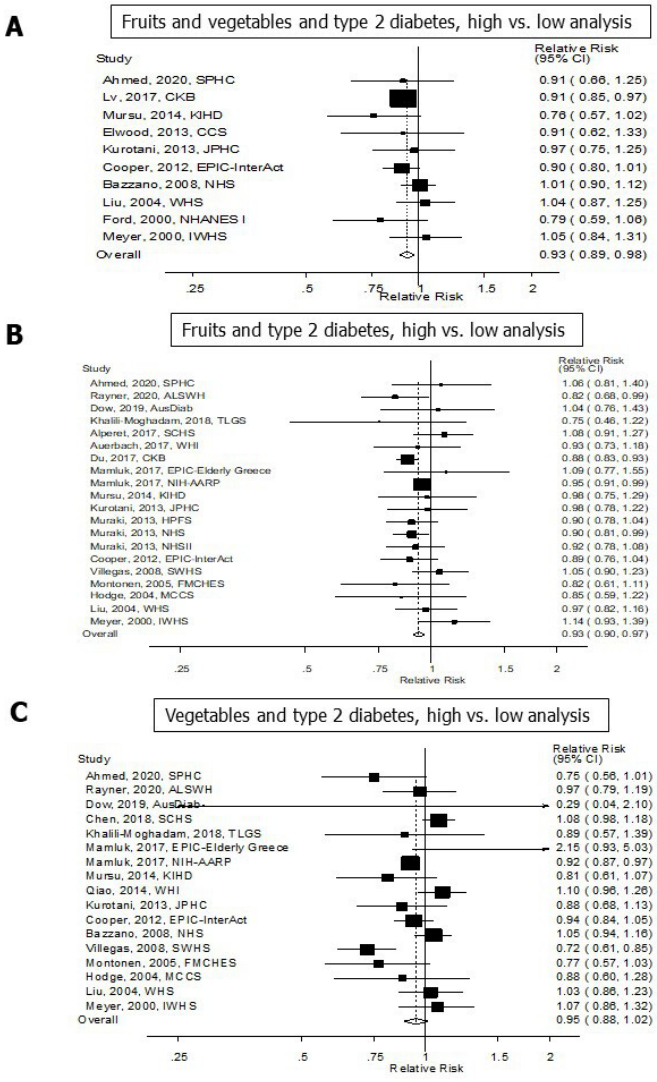

Figure 2 Fruits and vegetables and type 2 diabetes, high versus low analysis.

2 diabetes risk. All the studies were included in the high versus low analysis. The summary RR for high vs low intake was 0.93 (95% CI: 0.89 to 0.98) and there was no heterogeneity between studies (I^2=0% and $P_{heterogeneity}$=0.37) (figure 2A, table 1). For the linear dose–response analysis, seven[5 6 14–16 22 60] studies were included. The summary RR per 200 g/day was 0.98 (95% CI: 0.95 to 1.01, I^2=37.8%, $P_{heterogeneity}$=0.14) (figure 3A, table 1). There was no evidence of publication bias with Egger's test, p=0.41 or by inspection of the funnel plots (table 1,online supplemental figure 101). Although the test for non-linearity was not significant, $P_{non\text{-}linearity}$=0.13, there was a marginally significant 9%–10% reduction in risk at an intake of 600–700 g/day compared with 0 g/day (figure 3B, online supplemental table 6).

Fruits

A total of 20 cohort studies (17 publications)[6–10 12–23] (81 313 cases, 1 542 306 participants) investigated the association between total fruit intake and type 2 diabetes risk.

Table 1 Summary relative risks for high versus low and dose–response analyses of main exposures and type 2 diabetes

Main exposures	High versus low analysis					Dose–response analysis					
	n	RR (95% CI)	I^2	P_h	Egger	References	n	Increment	RR (95% CI)	I^2	P_h	Egger	References
Fruit and vegetables	10	0.93 (0.89 to 0.98)	0	0.47	0.95	5 6 14–17 22 42 58 60	7	Per 200 g/day	0.98 (0.95 to 1.01)	37.8	0.14	0.41	5 6 14–16 22 60
Fruits	20	0.93 (0.90 to 0.97)	9.3	0.34	0.47	6–10 12–23	19	Per 200 g/day	0.96 (0.92 to 1.00)	68.4	<0.0001	0.27	6–10 12–16 18–23
Vegetables	17	0.95 (0.88 to 1.02)	60.4	0.001	0.62	5 6 8 9 11 13–20 22–24	15	Per 200 g/day	0.97 (0.94 to 1.01)	39.2	0.06	0.03	5 6 8 9 11 13–16 18–20 22–24

n, number of studies; P_h, p value for heterogeneity; RR, relative risk.

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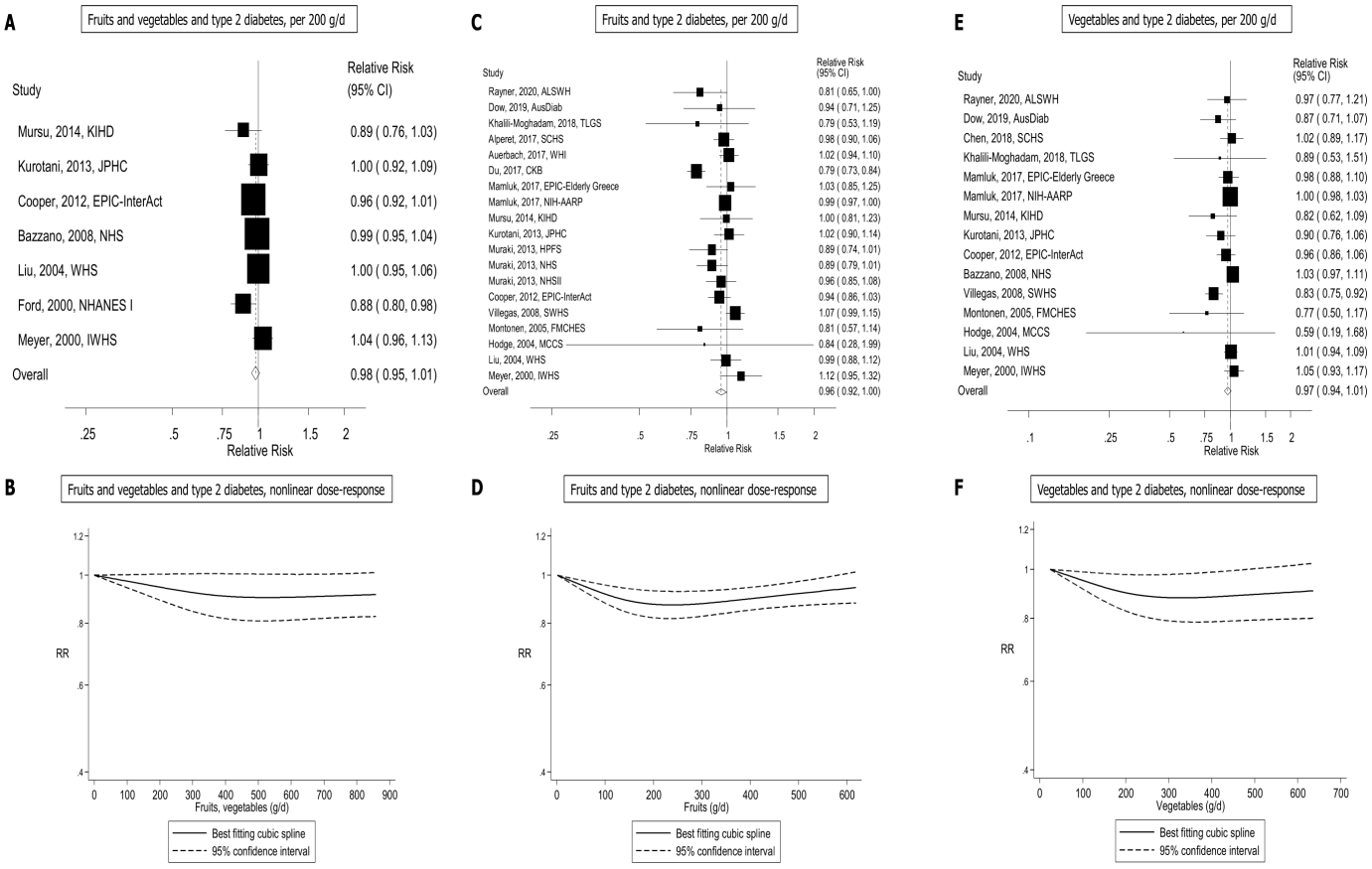

Figure 3 Fruits and vegetables and type 2 diabetes, linear and non-linear dose–response analysis.

All of the 20 studies were included in the high versus low analysis and 19 studies[6–10 12–16 18–23] were included in the linear dose–response analysis. The summary RR for high vs low intake was 0.93 (95% CI: 0.90 to 0.97) and the heterogeneity between studies was low (I^2=9.3% and $P_{heterogeneity}$=0.34) (figure 2B, table 1). The summary RR per 200 g/day was 0.96 (95% CI: 0.92 to 1.00, I^2=68.4%, $P_{heterogeneity}$ ≤0.001) (figure 3C, table 1). There was no evidence of publication bias with Egger's test, p=0.38 or by inspection of the funnel plots (table 1, online supplemental figure 102). There was evidence of a non-linear association, $P_{non-linearity}$=0.001, which showed an 8%–12% reduction in risk at an intake of 100–500 g/day (figure 3D,online supplemental table 6).

Vegetables

A total of 17 cohort studies (16 publications)[5 6 8 9 11 13–20 22–24] (52 959 cases, 983 953 participants) investigated the association between total vegetable intake and type 2 diabetes risk. All 17 studies were included in the high versus low analysis. The summary RR for high vs low intake was 0.95 (95% CI: 0.88 to 1.02) with moderate heterogeneity between studies (I^2=60.4% and $P_{heterogeneity}$ = 0.001) figure 2C, table 1). For the linear dose–response analysis, 15[5 6 8 9 11 13–16 18–20 22–24] were included. The summary RR per 200 g/day was 0.97 (95% CI: 0.94 to 1.01, I^2=39.2%, $P_{heterogeneity}$=0.06) (figure 3E, table 1). There was evidence of publication bias with Egger's test, p=0.03, and by inspection of the funnel plots (table 1, online supplemental figure 103). There was evidence of a non-linear association, $P_{non-linearity}$=0.004, and the risk reduction appeared to be steeper for lower intakes. There was a 14% risk reduction was observed at an intake of 300 g/day, with no further risk reduction at intake above this level (figure 3F, online supplemental table 6).

Subtypes of fruits and vegetables

Several studies investigated the association between subtypes of fruits and fruit juices/drinks and type 2 diabetes and results for these are shown in table 2, figure 4, online supplemental table 7-9 and 13, and online supplemental figures 1-51. Inverse associations were observed in the dose–response analyses with summary RRs per 100 g/day of 0.91 (95% CI: 0.88 to 0.95, I^2=0%, $P_{heterogeneity}$=0.87) for apples, 0.90 (95% CI: 0.83 to 0.97, I^2=38.4%, $P_{heterogeneity}$=0.18) for apples and pears, 0.90 (95% CI: 0.82 to 0.99, I^2=4.6%, $P_{heterogeneity}$=0.35) for grapefruit, and per 50 g/day of 0.60 (95% CI: 0.49 to 0.73, I^2=0%, $P_{heterogeneity}$=0.59) for blueberries and 0.74 (95% CI: 0.66 to 0.83, I^2=0%, $P_{heterogeneity}$=0.69) for grapes and raisins. Positive associations were observed with summary RRs of 1.18 (95% CI: 1.04 to 1.34, I^2=0%, $P_{heterogeneity}$=0.82) for cantaloupe, 1.13 (95% CI: 1.01 to 1.27, I^2=66.4%, $P_{heterogeneity}$=0.007) for fruit drinks, and borderline significant positive associations were observed with summary RRs of 1.08 (95% CI: 1.00 to 1.16, I^2=68.7%, $P_{heterogeneity}$=0.002) for fruit juice and 1.05

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Table 2 Summary relative risks for subtypes of fruits and type 2 diabetes, high versus low and dose–response analyses

	High versus low analysis						Dose–response analysis						
Fruit subtype	n	RR (95% CI)	I^2	P_h	Egger	References	n	Increment	RR (95% CI)	I^2	P_h	Egger	References
Apples	3	0.79 (0.72 to 0.87)	0	0.52	0.03	10 25 26	2	Per 100 g/day	0.91 (0.88 to 0.95)	0	0.87	–	10 26
Apples and pears	5	0.88 (0.77 to 1.00)	74.7	0.003	0.21	21 51 61	4	Per 100 g/day	0.90 (0.83 to 0.97)	38.4	0.18	0.98	21 61
Bananas	5	0.97 (0.84 to 1.13)	70.5	0.009	0.80	10 21 61	5	Per 100 g/day	0.93 (0.80 to 1.08)	84.4	<0.0001	0.72	10 21 61
Berries	5	0.89 (0.72 to 1.10)	79.6	0.001	0.27	8 21 22	5	Per 50 g/day	0.94 (0.77 to 1.14)	86.7	<0.0001	0.76	8 21 22
Blueberries	3	0.76 (0.67 to 0.87)	0	0.49	0.54	21	3	Per 50 g/day	0.60 (0.49 to 0.73)	0	0.59	0.70	21
Cantaloupe	3	1.11 (1.02 to 1.20)	0	0.57	0.37	21	3	Per 100 g/day	1.18 (1.04 to 1.34)	0	0.82	0.18	21
Citrus fruits	6	1.04 (0.98 to 1.11)	0	0.92	0.79	6 9 10 12 14 15	6	Per 100 g/day	1.02 (0.96 to 1.08)	46.9	0.09	0.29	6 9 10 12 14 15
Fruit drinks	6	1.28 (1.07 to 1.52)	62.0	0.02	0.37	22 40 63–66	7	Per 250 g/day	1.13 (1.01 to 1.27)	66.4	0.007	0.19	22 40 57 63–66
Fruit juice	8	1.09 (1.02 to 1.18)	44.2	0.08	0.08	12 21 23 29 50 59	8	Per 250 g/day	1.08 (1.00 to 1.16)	68.7	0.002	0.78	12 21 23 29 50 59
100% fruit juice	4	0.95 (0.84 to 1.08)	0	0.64	0.69	12 29 50 59	4	Per 250 g/day	0.97 (0.91 to 1.03)	0	0.86	0.31	12 29 50 59
Grapefruit	3	0.94 (0.81 to 1.10)	48.4	0.14	0.75	21	3	Per 100 g/day	0.90 (0.82 to 0.99)	4.6	0.35	0.44	21
Grapes and raisins	4	0.83 (0.76 to 0.91)	0	0.78	0.98	10 21	4	Per 50 g/day	0.74 (0.66 to 0.83)	0	0.69	0.45	10 21
Oranges	4	0.99 (0.93 to 1.06)	0	0.51	0.35	10 21	4	Per 100 g/day	0.97 (0.92 to 1.04)	0	0.89	0.53	10 21
Peaches, plums and apricots	3	0.91 (0.80 to 1.04)	2.6	0.36	0.72	21	3	Per 100 g/day	0.89 (0.73 to 1.09)	44.9	0.16	0.33	21
Prunes	3	0.94 (0.80 to 1.11)	34.0	0.22	0.63	21	3	Per 100 g/day	0.73 (0.52 to 1.02)	0	0.45	0.78	21
Strawberries	3	1.11 (0.90 to 1.38)	35.2	0.21	0.08	21	3	Per 50 g/day	1.10 (0.88 to 1.38)	76.5	0.01	0.24	21
Watermelon	2	1.06 (0.95 to 1.20)	0	0.64	–	9 10	2	Per 100 g/day	1.05 (1.00 to 1.11)	0	0.72	–	9 10

n, number of studies; P_h, p value for heterogeneity; RR, relative risk.

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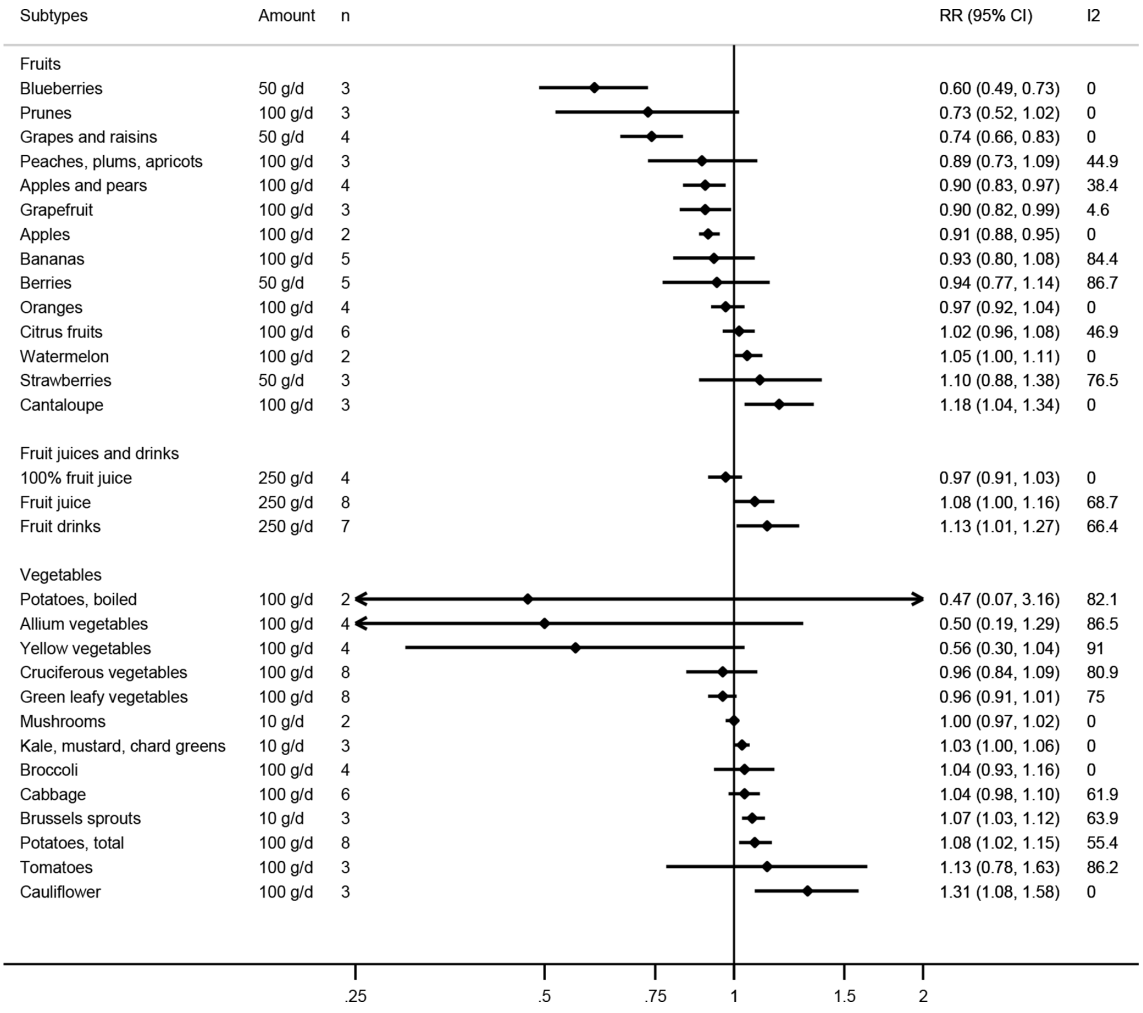

Figure 4 Fruit and vegetable subtypes and type 2 diabetes, linear dose–response analysis. RR, relative risk.

(95% CI: 1.00 to 1.11, I^2=0%, $P_{heterogeneity}$=0.72) for watermelon. No significant associations were observed for bananas, berries, citrus fruits, oranges, 100% fruit juice, peaches, plums and apricots, prunes, strawberries. Non-linear inverse associations were observed for bananas, $P_{non\text{-}linearity}$=0.04, blueberries, $P_{non\text{-}linearity}$=0.003, and grapes and raisins, $P_{non\text{-}linearity}$=0.01, with steeper reductions in risk at lower levels of intake, while a non-linear positive association was observed for cantaloupe, $P_{non\text{-}linearity}$=0.04, with steeper increase in risk at lower levels of intake. The inverse association between apples, apples and pears, grapefruit, prunes and type 2 diabetes appeared to be linear.

Results for vegetable subtypes are shown in table 3, figure 4, online supplemental tables 9-12, and online supplemental figures 52-90. Significant positive associations were observed in the dose–response analyses with summary RRs per 100 g/day of 1.31 (95% CI: 1.08 to 1.58, I^2=0%, $P_{heterogeneity}$=0.98) for cauliflower, and 1.08 (95% CI: 1.02 to 1.15, I^2=55.4%, $P_{heterogeneity}$=0.03) for potatoes (total) and the summary RRs per 10 g/day was 1.07 (95% CI: 1.03 to 1.12, I^2=63.9%, $P_{heterogeneity}$=0.06) for brussels sprouts, and a borderline significant summary RR of 1.03 (95% CI: 1.00 to 1.06, I^2=0%, $P_{heterogeneity}$=0.93) for kale, mustard and chard greens. No associations were observed for allium vegetables, potatoes (boiled), broccoli, cabbage, cruciferous vegetables, green leafy vegetables, mushrooms, tomatoes and yellow vegetables. Non-linear inverse associations were observed for allium vegetables $P_{non\text{-}linearity}$=0.045, and the risk reduction appeared to be steeper for lower intakes, with a flattening of the curve with increasing intakes. Non-linear positive associations were observed for cabbage $P_{no\text{-}linearity}$=0.04, with steeper increase in risk at lower levels of intake, and cauliflower $P_{non\text{-}linearity}$=0.03 with a slight increase in risk at increasing levels of intake. The association between brussels sprouts and type 2 diabetes appeared to be linear. There was evidence of publication bias in the analysis of cruciferous vegetables and type 2 diabetes (p=0.006), which remained significant (p=0.05) after exclusion of two apparently outlying studies[9 22] (online supplemental figure 104). The association remained non-significant when these two studies were excluded, summary RR=1.06 (95% CI: 0.98 to 1.15, I^2=57%), although the direction of the association changed. Although Egger's test was not significant in the analysis of green leafy vegetables and type 2 diabetes (p=0.46), there was some indication of asymmetry in the funnel plot (online supplemental figure 105), which

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Table 3 Summary relative risks for subtypes of vegetables and type 2 diabetes, high versus low and dose–esponse analyses

Vegetable subtype	High versus low analysis						Dose–response analysis					
	n	RR (95% CI)	I^2	P_h	Egger	References	n	Increment	RR (95% CI)	I^2	P_h	Egger	References
Allium vegetables	4	0.89 (0.66 to 1.20)	79.7	0.002	0.55	6 9 26 38	4	Per 100 g/day	0.50 (0.19 to 1.29)	86.5	<0.0001	0.18	6 9 26 38
Broccoli	4	1.06 (0.90 to 1.12)	64.1	0.04	0.85	26 43	4	Per 100 g/day	1.04 (0.93 to 1.16)	0	0.72	0.14	26 43
Brussels sprouts	3	1.18 (1.07 to 1.29)	54.9	0.11	0.48	43	3	Per 10 g/day	1.07 (1.03 to 1.12)	63.9	0.06	0.44	43
Cabbage	6	1.10 (1.02 to 1.19)	50.1	0.08	0.29	6 20 43	6	Per 100 g/day	1.04 (0.98 to 1.10)	61.9	0.02	0.47	6 20 43
Cauliflower	3	1.05 (1.00 to 1.10)	0	0.72	0.55	43	3	Per 100 g/day	1.31 (1.08 to 1.58)	0	0.98	0.03	43
Cruciferous vegetables	8	0.98 (0.87 to 1.11)	81.1	<0.0001	0.49	9 11 14 15 22 43	8	Per 100 g/day	0.96 (0.84 to 1.09)	80.9	<0.0001	0.006	9 11 14 15 22 43
Green leafy vegetables	8	0.93 (0.85 to 1.02)	76.5	<0.0001	0.31	5 6 9 11 14 15 20	8	Per 100 g/day	0.96 (0.91 to 1.01)	75.0	<0.0001	0.46	5 6 9 11 14 15 20
Kale, mustard and chard greens	3	1.10 (0.99 to 1.22)	0	0.69	0.90	43	3	Per 10 g/day	1.03 (1.00 to 1.06)	0	0.93	0.72	43
Mushrooms	2	1.04 (0.93 to 1.17)	0	1.00	–	62	2	Per 10 g/day	1.00 (0.97 to 1.02)	0	0.43	–	62
Potatoes, boiled	2	0.75 (0.34 to 1.69)	86.6	0.006	–	39 44	2	Per 100 g/day	0.46 (0.07 to 3.16)	82.1	0.02	–	39 44
Potatoes, total	8	1.11 (0.95 to 1.31)	75.0	<0.0001	0.44	8 11 13 15 39 44	8	Per 100 g/day	1.08 (1.02 to 1.15)	55.4	0.03	0.06	8 11 13 15 39 44
Tomatoes	3	0.93 (0.75 to 1.15)	82.7	0.003	0.59	9 11 67	3	Per 100 g/day	1.13 (0.78 to 1.63)	86.2	0.001	0.46	9 11 67
Yellow vegetables	4	0.77 (0.57 to 1.03)	92.1	<0.0001	0.50	8 9 11 15	4	Per 100 g/day	0.56 (0.30 to 1.04)	91.0	<0.0001	0.37	8 9 11 15

n, number of studies; P_h, p value for heterogeneity; RR, relative risk.

appeared to be driven by the studies by Cooper *et al*[6] and Kurotani *et al*[14] However, the results were not materially altered by exclusion of these two studies, summary RR=0.96 (95% CI: 0.92 to 1.01, I^2=78.4%). There was indication of publication bias in the analysis of potatoes (total) and type 2 diabetes (p=0.06), however, the asymmetry in the funnel plot indicated missing positive studies (online supplemental figure 106). Exclusion of one outlying study by Farhadnejad *et al*[39] attenuated Egger's test to 0.23, but did not substantially alter the results, summary RR=1.09 (95% CI: 1.04 to 1.14, I^2=40.2%).

Subgroup, meta-regression and sensitivity analyses

Subgroup and meta-regression analyses were conducted for fruit and vegetables combined, fruits, vegetables, potatoes (total), cruciferous vegetables and green leafy vegetables (online supplemental tables 14-19). There was no significant heterogeneity between subgroups in the analyses of fruits and vegetables combined, vegetables, green leafy vegetables and total potato intake and type 2 diabetes (online supplemental tables 14, 16, 18 and 19). For fruits, there was significant heterogeneity by whether studies adjusted for family history of diabetes, waist measures and energy intake or not (online supplemental table 15). Significant inverse associations were observed in the studies with adjustment for family history of diabetes, but not among those without such adjustment, while no association was observed among studies with adjustment for waist circumference and a weaker association was observed among studies with adjustment for energy intake compared with the studies with no such adjustment (online supplemental table 15). For cruciferous vegetables, there was significant heterogeneity between subgroups of studies that adjusted for ethnicity and waist circumference or waist-to-hip ratio compared with those that did not adjust for these factors, with a positive association among the studies with adjustment for ethnicity and an inverse association among studies with no such adjustment, and an inverse association among studies with adjustment for waist measures of adiposity compared with no association among those without such adjustment (online supplemental table 17).

The results for fruit and vegetables combined (dose response), fruits (high vs low), vegetables (high vs low, dose response), and cruciferous vegetables (dose response) appeared to be robust in sensitivity analyses excluding one study at a time from the analysis (online supplemental figures 92, 93, 95, 96 and 97). In contrast, the results in the high versus low analysis of fruit and vegetables combined and dose–response analyses of fruits, fruit drinks, green leafy vegetables and total potatoes were sensitive to the influence of individual studies (online supplemental figures 91, 94, 98, 99 and 100).

Evidence grading

Using World Cancer Research Fund criteria for evaluating evidence[68] (online supplemental table 20), we considered the overall grading of the evidence to be supportive

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of a probably causal relationship between fruit intake and lower risk of type 2 diabetes, while the evidence was considered limited-suggestive for fruit and vegetables combined, and limited - no conclusion for vegetables (online supplemental tables 21-22). A detailed justification for this judgement is found in online supplemental table 21. All subtypes of fruits and vegetables were either in the category of limited-suggestive evidence or limited - no conclusion, primarily because of the limited number of studies and/or lack of robustness of the summary estimates in sensitivity analyses (online supplemental table 22).

DISCUSSION

This up-to-date meta-analysis suggests that a high intake of fruit and vegetables combined and fruit is associated with a small reduction in risk of type 2 diabetes, however, some specific types of fruits including apples and pears, blueberries, grapes and raisins were more strongly associated with reduced risk. In the high versus low analyses, we observed a 7% reduction in RR of type 2 diabetes for intake of both fruit and vegetables combined and for total fruit, but the association with the intake of vegetables was not significant. Although the associations were not significant in the linear dose–response analyses, there was evidence of non-linearity in several analyses and there were significant 8%–12% reductions in risk with a fruit intake between 100–500 g/day and 12%–14% reduction in risk with a vegetable intake between 200–400 g/day, and a borderline significant 9%–10% reduction in risk was observed at an intake of 600–700 g/day of fruit and vegetables combined. Several subtypes of fruits were more strongly inversely associated with type 2 diabetes than total fruit intake with 12%–24% reductions in risk in the high versus low analysis, including apples, apples and pears combined, blueberries, grapefruit, grapes and raisins. In contrast, intakes of cantaloupe, fruit drinks, fruit juice, potatoes (total), brussels sprouts, and cauliflower were positively associated with type 2 diabetes risk, and borderline significant positive associations were observed for kale, mustard and chard greens and watermelon. No associations were observed for bananas, berries, citrus fruits, oranges, 100% fruit juice, peaches, plums and apricots, prunes, strawberries, allium vegetables, potatoes (boiled), broccoli, cabbage, cruciferous vegetables, green leafy vegetables, mushrooms, tomatoes and yellow vegetables and type 2 diabetes. However, the analyses of these subtypes were based on relatively few studies and some of the observed associations could partly be due to selective reporting. Further studies on specific subtypes of fruit and vegetables are therefore needed before firm conclusions can be drawn with regard to the association between a number of subtypes of fruits and vegetables and risk of type 2 diabetes.

The current meta-analysis found inverse associations between high versus low intake of fruit and vegetables combined and risk of type 2 diabetes based on eight studies, while previous meta-analyses[6 33] found non-significant associations based on five and seven studies, respectively. This meta-analysis is consistent with some,[33 34] but not all[6] meta-analyses, which found inverse associations with fruit, apples and pears,[31] and positive associations with fruit juice,[32] and with the lack of association previously reported for total vegetable intake,[6 33 34] but in contrast to some that reported inverse associations with green leafy vegetables[6 33] and cruciferous vegetables.[11] The difference in the findings regarding green leafy vegetables and cruciferous vegetables is likely due to the larger number of studies included in the current analysis than in most previous meta-analyses.

Mechanisms

The observed protective effect of fruit and vegetables on the risk of type 2 diabetes may be explained by their high content of dietary fibre, antioxidants, vitamins, minerals and phytochemicals, such as polyphenols, carotenoids, anthocyanins and quercetin. Antioxidant phytochemicals could reduce type 2 diabetes risk through their antioxidant and anti-inflammatory properties.[69] Blueberries, apples and grapes have a high content of anthocyanins and quercetin.[70–72] In experimental studies in diabetic rats, anthocyanins have shown anti-diabetic effects through glucose transporter 4 regulation,[73] and quercetin has shown protective effects through decreased oxidative stress and protection against beta-cell damage.[74] In intervention trials in humans, blueberries, alone or in combination with fibre supplements, have been shown to improve insulin sensitivity,[75] reduce blood glucose[76 77] and C reactive protein.[76]

It is also possible that fruit and vegetable intake may reduce type 2 diabetes risk by reducing adiposity and weight gain over time. A pooled analysis of three American cohort studies found inverse associations between increased intake of fruit and vegetables and 4-year weight change and particularly intakes of blueberries, prunes, apples/pears, strawberries, raisins and grapes, grapefruit and cauliflower and squash appeared to be beneficial.[78] The stronger inverse association between intake of fruits and 4-year weight change than for vegetables (-0.53 vs −0.25 lb per serving increase) is consistent with the significant inverse association observed for fruit and type 2 diabetes, but not for vegetables in the current analysis, although the difference in the strength of the summary estimates in our meta-analysis was small. In addition, some of the fruit subtypes which were most beneficial in reducing weight gain, including blueberries, apples/pears, raisins/grapes, and grapefruit, were also the fruits that were found to be associated with reduced risk of type 2 diabetes in the current analysis. Most studies included in the current analysis adjusted for baseline body mass index however, few studies conducted analyses with and without adjustment for body mass index to assess potential mediation by adiposity. In addition, no studies tested whether adjustment for weight change during the follow-up, which also potentially could mediate part of the inverse

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association between fruit and vegetable intake and type 2 diabetes risk, affected the observed associations. Further studies could clarify this question. The increased type 2 diabetes risk observed with intake of fruit juice and fruit drinks may be due to the high glycaemic load (GL) and the added sugar in fruit drinks, as well as the lack of dietary fibre, which reduces satiety and leads to more rapid and larger postprandial increases in blood glucose than for whole fruit.[79] Potatoes contain large amounts of rapidly absorbed starch and has high Glycaemic Index (GI) and GL,[28] which lead to rapid increases in blood glucose and insulin concentrations, and higher GI/GL is associated with an increased risk for type 2 diabetes.[80] Both intake of fruit juices and potatoes has been associated with excess weight gain over time and this could also contribute to an increased risk of type 2 diabetes.[81]

Limitations

This meta-analysis has some limitations that should be considered when interpreting the results. As this meta-analysis is based on studies from different populations with differences in the (1) amounts and ranges of fruit and vegetable intakes, (2) cooking and preparation methods, (3) dietary patterns, (4) prevalence of confounding factors, (5) rates of type 2 diabetes and (6) the detail of the dietary assessment used, some heterogeneity is expected between studies. Most of the included studies adjusted for lifestyle factors such as overweight and obesity, physical activity and smoking, that are common risk factors for type 2 diabetes, as well as other possible confounding factors. In the dose–response analysis, the heterogeneity was moderate for vegetables and for fruit and vegetables, and high for fruits. However, when exploring the reason for heterogeneity through subgroup and meta-regression analyses, we found little evidence that the results were materially altered whether these confounding factors were adjusted for or not. Nevertheless, relatively few of the available studies adjusted for other dietary factors and residual confounding can therefore not be completely ruled out. We can also not exclude the possibility that confounding from other risk factors could have affected the observed associations.

Most studies used dietary assessment methods relying on self-report, such as food frequency questionnaires (FFQs), to assess fruit and vegetable intake. Although nearly all studies used FFQs that had been validated, measurement errors are known to affect results of epidemiological studies on diet and health and may have biased the observed effect estimates. However, because we only included prospective studies any measurement errors in the assessment of fruit and vegetable intake would most likely have attenuated the observed associations toward the null. None of the studies included in this meta-analysis made any attempts to correct for measurement errors, however, previous studies on fruit and vegetable intake and coronary heart disease and mortality found risk reductions which were twice as strong after correcting for measurement errors compared with the uncorrected risk estimates.[82 83] In addition, a recent analysis in the EPIC-InterAct study found much stronger inverse associations between several plasma biomarkers of fruit and vegetable intake, including vitamin C, carotenoids, alpha-carotene, beta-carotene, lycopene, lutein, beta-cryptoxanthin and a composite biomarker score and type 2 diabetes risk with HRs of 0.45–0.79 for the highest vs lowest quintile, than what was observed for fruit and vegetable intake as assessed by FFQ in the same study with HRs of 0.84–0.97.[6 84] Since most of the included studies only assessed fruit and vegetable intake at baseline and not during the follow-up, we also cannot exclude the possibility that participants may have changed their intake over time, however, any regression dilution bias would likely attenuate associations toward the null. Several of the included studies based the assessment of outcome on self-reported type 2 diabetes. However, [20]the vast majority of the studies either validated or supplemented the self-reported diabetes diagnoses through record linkage, medication use or supplementary questionnaires.

As with any meta-analysis of published studies, we cannot rule out the possibility that publication bias may have affected the observed results. In the current analysis, there was some indication of publication bias with Egger's test in the analysis of vegetables, total potatoes and cruciferous vegetables, and there was some evidence of asymmetry in the funnel plot for green leafy vegetables, although Egger's test was not significant in the latter analysis. We found that Egger's test and/or the asymmetries in the funnel plots in some cases were explained by one or two outlying studies, which when excluded did not materially alter the results.

Because there was a limited number of studies in the analyses for many subtypes of fruits and vegetables and because of the potential for selective reporting of significant results, these findings need to be interpreted with caution. For example, we found no association overall between cruciferous vegetable intake, but for some subtypes of this category including cabbage, cauliflower and kale, mustard and chard greens there were positive associations with type 2 diabetes. However, these latter results were based on data from only three studies (Nurses' Health Study (NHS), NHS II, and Health Professionals Follow-up Study).[43] Since the same three studies were the only studies that reported increased type 2 diabetes risk with total cruciferous vegetable intake, which was counter-acted by null or inverse associations in five other studies leading to an overall null association for total cruciferous vegetable intake, it is possible that selective reporting, publication bias and/or chance may explain the positive associations observed for the specific subtypes of cruciferous vegetables. Alternatively, these three studies may have had a better measure of long-term diet because of repeated measurements over time and therefore better been able to detect an association. Further studies are urgently needed to provide firm conclusions on the association between subtypes of fruits and vegetables and risk of type 2 diabetes. One last

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limitation is that there was no registered protocol for the current meta-analysis.

Strengths

Strengths of the present meta-analysis include the comprehensive search strategy with broad search terms, duplicate screening and assessment of the included studies, the large number of studies included, the large sample size which increases the precision of the effect estimate estimates, and the high study quality of the included studies. We conducted high versus low, linear and non-linear dose–response analyses of fruit and vegetables combined, separately, and across subtypes of fruit and vegetables, and in addition, we conducted detailed subgroup and sensitivity analyses. The detailed dose–response analyses allowed us to clarify the strength and shape of the dose–response relationship between fruit and vegetable intake and type 2 diabetes. The associations were in general consistent when stratified by adjustment for different confounding factors in the subgroup analyses, suggesting that these factors did not substantially affect the results. The prospective design of the included studies minimised the possibility for recall bias and reduced the possibility for selection bias, and the study quality was relatively high across studies. The factors that most frequently contributed to a less than optimal study quality score was a short duration of follow-up and, lack of reporting of participants lost to follow-up.

Public health implications

This meta-analysis provides the most comprehensive and up-to-date summary of the available evidence to date and have important public health implications given the current epidemic of adiposity and diabetes globally.[85] The current meta-analysis supports public health recommendations to increase fruit intake for the prevention of type 2 diabetes. Although the overall evidence was weaker for intakes of fruit and vegetables combined, and for vegetables, recommendations should still also emphasise increased intake of vegetables given multiple other health benefits of vegetable intake.[86] The findings also suggest that specific types of fruits and possibly vegetables may be more important for the prevention of type 2 diabetes than others, however, further studies are urgently needed on fruit and vegetable subtypes and type 2 diabetes before firm conclusions can be drawn. These findings are partly consistent with a previous meta-analysis, which showed benefits of fruits and vegetables and certain subtypes on risk of cardiovascular disease, cancer and all-cause mortality.[86]

CONCLUSION

This study supports existing recommendations to increase the intake of fruit and vegetables for the prevention of type 2 diabetes, but suggest certain subtypes of fruits including apples, blueberries, grapefruit, grapes and raisins may be particularly beneficial, while potatoes and fruit juice may increase the risk. Any further studies should report in more detail associations between subtypes of fruits and vegetables and type 2 diabetes, assess potential mediation by adiposity, adjust for more dietary confounders and report analyses stratified by other risk factors to better be able to rule out residual confounding.

Author affiliations
[1]Department of Nursing and Health Promotion, Faculty of Health Science, Oslo Metropolitan University, Oslo, Norway
[2]Department of Nutrition, Bjørknes University College, Oslo, Norway
[3]Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, UK
[4]Department of Endocrinology, Morbid Obesity and Preventive Medicine, Oslo University Hospital, Oslo, Norway
[5]Unit of Cardiovascular and Nutritional Epidemiology, Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden

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ORCID iD
Mathilde Elvestad http://orcid.org/0000-0003-1007-9499

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Supplemental Table 1. Search strategy in PubMed

1. fruits
2. vegetables
3. fruit
4. vegetable
5. berry
6. berries
7. strawberries
8. blueberries
9. citrus
10. “citrus fruits”
11. orange
12. apples
13. pears
14. banana
15. cruciferae
16. “cruciferous vegetables”
17. broccoli
18. cauliflower
19. cabbages
20. “allium vegetables”
21. onion
22. garlic
23. tomato
24. tomatoes
25. potato
26. "french fries"
27. juice
28. food
29. “food groups”
30. (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 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29)
31. diabetes
32. “case-control”
33. cohort
34. cohorts
35. prospective
36. longitudinal
37. retrospective
38. “follow-up”
39. “cross-sectional”
40. “population-based”
41. "relative risk"
42. "odds ratio"
43. "hazard ratio"
44. "incidence rate ratio"
45. (32 OR 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41 OR 42 OR 43 OR 44)
46. (30 AND 31 AND 45)

Supplemental Table 2. List of excluded studies and exclusion reason

Exclusion reason	Reference number
Abstract	(1-4)
Case-control study	(5-8)
Commentary	(9)
Cross-sectional study	(10-55)
Diabetes mortality	(56)
Dietary pattern, dietary index	(57-59)
Duplicate	(60-70)
Impaired glucose tolerance population	(71)
Meta-analysis	(72-88)
No risk estimates	(89-91)
Not original data	(92;93)
Not relevant data	(94-195)
Not relevant exposure	(196-424)
Not relevant outcome	(425-477)
Only one study on exposure	(478;479)
Patient population	(480)
Protocol	(481-483)
Review	(484-517)
Substitution of juice with water	(518)
Unadjusted risk estimates	(519)
Unspecific exposure (plant foods)	(520)

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Supplemental Table 3. Serving sizes

Exposure	Serving size (g/d)[a]	Serving size (g/d)[b]
Main exposures		
Fruit and vegetables		
Fruits	-	80
Vegetables	-	80
Subtypes of fruit		
Apples	138	-
Apples and pears	138	-
Bananas	114	-
Berries	-	75
Blueberries	-	70
Cantaloupe	134	-
Citrus fruits	-	110
Fruit drinks	-	250
Fruit juice	-	250
100% fruit juice	-	250
Grapefruit	120	-
Grapes and raisins	-	49
Oranges	131	-
Peaches, plums and apricots	87	-
Prunes	-	85
Strawberries	75	-
Watermelon	-	286
Subtypes of vegetables		
Allium vegetables	-	160
Boiled potato	-	202
Broccoli	78	-
Brussel sprouts	78	-
Cabbage	68	-
Cauliflower	62	-
Cruciferous vegetables	-	72
Green leafy vegetables	-	73
Kale, mustard and chard greens	-	73
Mushrooms	-	30
Potatoes	202	-
Tomatoes	122	-
Yellow vegetables	-	93

[a] Serving sizes retrieved from Lee et al. (2009)
[b] Estimated values based on Lee et al. (2009)

Lee, J. E., Mannisto, S., Spiegelman, D., Hunter, D. J., Bernstein, L., van den Brandt, P. A., . . . Smith-Warner, S. A. (2009). Intakes of fruit, vegetables, and carotenoids and renal cell cancer risk: a pooled analysis of 13 prospective studies. *Cancer Epidemiol Biomarkers Prev, 18*(6), 1730-1739. doi:10.1158/1055-9965.epi-09-0045

Supplemental Table 4. Cohort studies of fruit and vegetables and type 2 diabetes

Author, publication year, country	Study name or description	Follow-up period	Study size, gender, age, number of cases	Dietary assessment	Outcome assessment	Exposure	Quantity	RR (95% CI)	Adjustment for confounders
Ford ES et al, 2000, USA	NHANES I Epidemiologic Follow-Up Study	1971-1975 to 1992-1993, 15.8 years follow-up	9665 participants, age 25-74 years, 1018 cases	Single 24-hour dietary recall	Self-report, hospitalization record, death certificate	Fruit and vegetable (total) Fruit and vegetable (men) Fruit and vegetable (women)	0 serv/d 1-4 ≥5 0 serv/d 1-4 ≥5 0 serv/d 1-4 ≥5	1.00 1.01 (0.78, 1.29) 0.79 (0.59, 1.06) 1.00 1.23 (0.76, 1.99) 1.14 (0.67, 1.93) 1.00 0.85 (0.62, 1.16) 0.61 (0.42, 0.88)	Age, sex, smoking, systolic blood pressure, cholesterol concentration, use of antihypertensive medication, recreational exercise, nonrecreational activity, alcohol use, BMI, education
Meyer KA et al, 2000, USA	Iowa Women's Health Study (IWHS)	1986-1992, 6 years follow-up	35 988 women, age 55-69 years, 1141 cases	Validated FFQ, 127 items	Self-reported, validated by physician/medical records	Total fruit and vegetable Total fruit Total vegetable	18.0 serv/wk 27.0 35.0 44.0 62.0 4.0 serv/wk 8.5 12.0 16.0 23.5 11.0 serv/wk 17.0 22.0 28.5 41.5	1.00 1.00 (0.82, 1.22) 1.12 (0.92, 1.36) 1.21 (0.99, 1.49) 1.05 (0.84, 1.31) 1.00 1.05 (0.87, 1.26) 1.00 (0.82, 1.22) 1.08 (0.88, 1.32) 1.14 (0.93, 1.39) 1.00 1.03 (0.85, 1.24) 0.99 (0.82, 1.21) 1.09 (0.90, 1.34) 1.07 (0.86, 1.32)	Age, total energy intake, BMI, WHR, education, smoking, alcohol intake, physical activity
Knekt P et al, 2002, Finland	Finnish Mobile Clinic Health Examination Survey (FMCHES)	1966-1972 to 1994, 28 years follow-up	9878 participants, age >15 years, 526 cases	Dietary history interview, >100 items	Linkage to the Social Insurance Institution	Apple	>47 vs. 0 g/d	0.73 (0.57, 0.92)	Sex, age, intakes of vegetables and fruit other than apples

Hodge AM et al, 2004, Australia	Melbourne Collaborative Cohort Study (MCCS)	1990-1994, 4 years follow-up	31 641 participants, age 27-75 years, 365 cases	Self-administered FFQ, 121 items	Self-reported/ doctor confirmation	Vegetable	<3.0 times/d	1.00	Age, sex, country of birth, physical activity, family history of diabetes, alcohol, education, weight change in the last 5 years, energy intake, BMI, WHR
							3.0-4.9	1.09 (0.78, 1.54)	
							5.0-6.9	0.97 (0.68, 1.39)	
							≥7.0	0.88 (0.60, 1.28)	
							Increase of 1 time/wk	0.97 (0.91, 1.03)	
						Potato	<2.0 times/wk	1.00	
							2.0-3.9	0.84 (0.63, 1.12)	
							4.0-6.4	0.82 (0.60, 1.12)	
							≥6.5	0.98 (0.70, 1.37)	
							Increase of 1 time/wk	0.99 (0.94, 1.04)	
						Fruit	<2.0 times/d	1.00	
							2.0-3.9	0.81 (0.59, 1.12)	
							4.0-5.9	0.82 (0.58, 1.16)	
							>6.0	0.85 (0.59, 1.22)	
							Increase of 1 time/wk	0.99 (0.93, 1.04)	
Liu S et al, 2004, USA	Women's Health Study (WHS)	1993-2003, 8.8 years follow-up	38 018 women, age ≥45 years, 1614 cases	Validated semi-quantitative FFQ, 131 items	Self-reported/ADA criteria	All fruits and vegetables	2.54 serv/d	1.00	Age, smoking, total calories, alcohol use, BMI, exercise, history of hypertension, history of high cholesterol and family history of diabetes
							4.13	1.03 (0.88, 1.20)	
							5.49	0.94 (0.79, 1.11)	
							7.09	0.93 (0.78, 1.10)	
							10.16	1.04 (0.87, 1.25)	
						All fruits	0.62 serv/d	1.00	
							1.32	0.93 (0.79, 1.09)	
							1.91	0.87 (0.74, 1.03)	
							2.62	0.94 (0.80, 1.11)	
							3.91	0.97 (0.82, 1.16)	
						All vegetables	1.47 serv/d	1.00	
							2.49	1.01 (0.86, 1.19)	
							3.40	0.98 (0.83, 1.16)	
							4.58	0.99 (0.84, 1.18)	
							6.84	1.03 (0.86, 1.23)	
						Citrus fruits	0.07 serv/d	1.00	
							0.28	1.06 (0.90, 1.24)	
							0.57	0.90 (0.76, 1.07)	
							1.00	1.14 (0.98, 1.34)	
							1.57	1.07 (0.90, 1.26)	
						Green leafy vegetables	0.14 serv/d	1.00	
							0.35	0.92 (0.79, 1.08)	
							0.56	0.93 (0.79, 1.09)	
							0.92	0.84 (0.72, 0.99)	
							1.42	0.96 (0.81, 1.13)	

						Cruciferous vegetables Dark yellow vegetables Potatoes	0.13 serv/d 0.21 0.35 0.57 1.00 0.07 serv/d 0.2 0.34 0.57 1.00 0.13 serv/d 0.28 0.43 0.56 0.93	1.00 0.91 (0.76, 1.09) 0.98 (0.84, 1.14) 0.96 (0.81, 1.14) 0.95 (0.80, 1.12) 1.00 0.90 (0.76, 1.07) 0.89 (0.75, 1.07) 0.92 (0.76, 1.11) 0.81 (0.67, 0.98) 1.00 1.03 (0.87, 1.22) 0.97 (0.79, 1.19) 0.96 (0.81, 1.13) 1.02 (0.86, 1.22)	
Schulze M et al, 2004, USA	Nurses' Health Study II (NHS II)	1991-1999, 7.8 years follow-up	91 249 women, age 24-44 years, 741 cases	Validated semi-quantitative FFQ, 133 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998)	Fruit punch	<1/mo 1-4/ 2-6/wk ≥1/d	1.00 0.90 (0.68, 1.18) 1.15 (0.79, 1.66) 2.00 (1.33, 3.03)	Alcohol intake, physical activity, family history of diabetes, smoking, postmenopausal hormone use, oral contraceptive use, intake of cereal fiber, magnesium, trans-fat, and ratio of polyunsaturated to saturated fat; and consumption of sugar-sweetened soft drinks, diet soft drinks, fruit juice, and fruit punch (other than the main exposure, depending on model)
Montonen J et al, 2005, Finland	Finnish Mobile Clinic Health Examination	1967-1972 to 1995, 23 years follow-up	4304 participants, age 40-69	Dietary history interview, > 100 food items	Linkage to the Social Insurance Institution	Potato	<132 g/d 132-196 197-283 >283	1.00 1.09 (0.82, 1.46) 1.27 (0.94, 1.72) 1.42 (1.02, 1.98)	Age, sex, BMI, energy intake, smoking, family

	Survey (FMCHES)		years, 383 cases			Vegetables Yellow and red vegetables Green vegetables Other vegetables Fruits and berries Fruit Berries	<42 g/d 42-78 79-130 >130 <19 g/d 19-41 42-77 >77 <11 g/d 11-24 25-43 >43 <1 g/d 1-3 4-10 >10 <33 g/d 33-83 84-156 >156 <20 g/d 20-66 67-138 >138 <4 g/d 4-10 11-20 >20	1.00 0.75 (0.56, 1.00) 0.93 (0.70, 1.22) 0.77 (0.57, 1.03) 1.00 0.78 (0.59, 1.04) 0.90 (0.68, 1.18) 0.80 (0.60, 1.06) 1.00 0.92 (0.71, 1.21) 0.91 (0.69, 1.20) 0.69 (0.50, 0.93) 1.00 0.97 (0.73, 1.30) 0.94 (0.71, 1.24) 0.79 (0.58, 1.07) 1.00 0.77 (0.58, 1.02) 0.83 (0.63, 1.10) 0.69 (0.51, 0.92) 1.00 0.89 (0.67, 1.18) 0.88 (0.66, 1.17) 0.82 (0.61, 1.11) 1.00 0.69 (0.53, 0.92) 0.65 (0.49, 0.87) 0.63 (0.47, 0.85)	history of diabetes, geographic area
Song Y et al, 2005, USA	Women's Health Study (WHS)	1993-2003, 8.8 years follow-up	38 018 women, age ≥45 years, 1614 cases	Validated semi-quantitative FFQ, 131 items	Self-reported, validated by supplementary questionnaire and ADA criteria	Broccoli Apples Onions	None ≤1 serv/wk 2-4 ≥5 None ≤1 serv/wk 2-6 ≥1/d None ≤1 serv/wk 2-4 ≥5	1.00 0.95 (0.77, 1.16) 0.94 (0.75, 1.18) 0.95 (0.69, 1.31) 1.00 0.83 (0.70, 0.98) 0.73 (0.60, 0.88) 0.72 (0.55, 0.94) 1.00 1.09 (0.97, 1.22) 1.10 (0.92, 1.33) 1.18 (0.94, 1.48)	Age, BMI, total energy intake, smoking, exercise, alcohol use, history of hypertension, history of high cholesterol, family history of diabetes, fiber intake, glycemic load, magnesium, total fat

Wang L et al, 2006, USA	Women's Health Study (WHS)	1992-2003, 10.2 years follow-up	35 783 women, age ≥45 years, 1544 cases	Validated semi-quantitative FFQ, 131 food items	Self-reported, validated by supplementary questionnaire and ADA criteria	Tomatoes Tomato juice	None 1–3 serv/mo 1–4 serv/wk ≥5 None 1–3 serv/mo 1 serv/wk ≥2	1.00 0.81 (0.64, 1.03) 0.94 (0.76, 1.17) 0.95 (0.74, 1.22) 1.00 1.00 (0.88, 1.13) 1.11 (0.94, 1.31) 0.93 (0.74, 1.15)	Age, energy, randomized treatment assignment, smoking, alcohol, exercise, family history of diabetes, post-menopause, postmenopausal hormone use, multivitamin use, BMI, history of hypertension, history of hyper-cholesterolemia
Montonen J et al, 2007, Finland	Finnish Mobile Clinic Health Examination Survey (FMCHES)	1967-1972 to 1994-1995, 12 years follow-up	4284 participants, age 40-69 years, 177 cases	Dietary history interview, >100 food items	Linkage to the Social Insurance Institution	Sweetened berry juice	0 g/d 7.5 21 51	1.00 0.68 (0.41, 1.14) 0.95 (0.60, 1.49) 1.56 (1.08, 2.26)	Age, sex, BMI, energy intake, smoking, geographic area, physical activity, family history of diabetes, prudent dietary pattern score, conservative pattern score, serum cholesterol, blood pressure, history of infarction, history of angina pectoris, history of cardiac failure
Bazzano LA et al, 2008, USA	Nurses' Health Study (NHS)	1984-2002, 18 years follow-up	71 346 women, age 38-63 years, 4529 cases	Validated semi-quantitative FFQ, 116 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes	Vegetables Fruit and vegetables (fruit juice excluded)	1.61 serv/d 2.35 3.09 4.25 5.40 3 serv/d increase 2.35 serv/d 3.41 4.47	1.00 1.00 (0.91, 1.10) 1.02 (0.93, 1.12) 1.08 (0.98, 1.19) 1.05 (0.94, 1.16) 1.04 (0.97, 1.13) 1.00 1.01 (0.92, 1.11) 1.00 (0.91, 1.10)	Age, BMI, physical activity, family history of diabetes, postmenopausal hormone use, alcohol, smoking, total energy intake, whole grains, nuts, processed meats,

					criteria (after 1998)		6.07	0.99 (0.89, 1.09)	coffee, potatoes, and sugar-sweetened soft drinks
							7.66	1.01 (0.90, 1.12)	
							3 serv/d increase	0.99 (0.94, 1.05)	
						Green leafy vegetables	0.25 serv/d	1.00	
							0.49	1.00 (0.91, 1.10)	
							0.72	1.02 (0.93, 1.11)	
							1.10	0.93 (0.85, 1.03)	
							1.48	0.90 (0.82, 1.00)	
							1 serv/d increase	0.91 (0.84, 0.98)	
						Apple, orange, grapefruit/other fruit juices	0.04 serv/d	1.00	
							0.29	1.21 (1.10, 1.33)	
							0.54	1.29 (1.17, 1.42)	
							0.94	1.25 (1.14, 1.38)	
							1.33	1.35 (1.22, 1.50)	
							1 serv/d increase	1.18 (1.10, 1.26)	
Palmer JR et al, 2008, USA	Black Women's Health Study (BWHS)	1995-2005, 10 years follow-up	43 960 women, age 21-69 years, 2713 cases	Validated FFQ, 68-items	Self-reported, validated by physician	Sweetened fruit drink	<1 drink/mo	1.00	Age, family history of diabetes, physical activity, cigarette smoking, years of education, and each of the 2 other types of drinks, intake of red meat, processed meats, cereal fiber, and coffee, and glycemic index
							1-7	1.08 (0.96, 1.22)	
							2-6 drinks/wk	1.08 (0.96, 1.21)	
							1 drink/d	1.17 (1.02, 1.33)	
							≥2	1.31 (1.13, 1.52)	
						Orange or grapefruit juice	<1 drink/mo	1	
							1-7	0.93 (0.83, 1.05)	
							2-6 drinks/wk	0.99 (0.88, 1.11)	
							1 drink/d	0.99 (0.87, 1.14)	
							≥2	1.11 (0.92, 1.35)	
Villegas R et al, 2008, China	Shanghai Women's Health Study (SWHS)	2000-2002 and 2002-2004, 4.6 years follow-up	64 191 women, age 40-70 years, 1608 cases	In-person interview with FFQ, 77 items	Self-reported/ validated by fasting glucose level (ADA criteria) and/or an oral glucose tolerance test (OGTT) and/or use of hypoglycaemic medication	All vegetables	121.5 g/d	1.00	Age, daily energy intake, meat intake, BMI, WHR, smoking, alcohol consumption, physical activity, income level, education level, occupational status, and hypertension
							181.6	0.74 (0.64, 0.87)	
							236.0	0.68 (0.58, 0.80)	
							302.6	0.72 (0.61, 0.84)	
							428.0	0.72 (0.61, 0.85)	
						Cruciferous vegetables	5.0 g/d	1.00	
							10.9	0.79 (0.68, 0.91)	
							17.0	0.69 (0.60, 0.81)	
							25.8	0.60 (0.51, 0.71)	
							45.2	0.72 (0.61, 0.83)	
						Green leafy vegetables	28.0 g/d	1.00	
							51.3	0.78 (0.68, 0.91)	
							70.7	0.61 (0.52, 0.71)	
							94.1	0.58 (0.49, 0.68)	

							136.1	0.82 (0.71, 0.95)	
						Yellow vegetables	0.04 g/d	1.00	
							0.62	0.69 (0.60, 0.80)	
							2.0	0.63 (0.54, 0.73)	
							5.6	0.51 (0.43, 0.60)	
							17.3	0.55 (0.47, 0.64)	
						Allium vegetables	2.2 g/d	1.00	
							4.2	0.79 (0.68, 0.92)	
							6.5	0.70 (0.60, 0.81)	
							9.8	0.70 (0.60, 0.82)	
							17.9	0.69 (0.59, 0.81)	
						Tomatoes	6.8 g/d	1.00	
							17.0	0.68 (0.59, 0.79)	
							30.3	0.73 (0.63, 0.85)	
							49.2	0.61 (0.52, 0.71)	
							88.5	0.78 (0.67, 0.91)	
						Other vegetables	40.7 g/d	1.00	
							66.8	0.76 (0.65, 0.88)	
							90.9	0.84 (0.72, 0.98)	
							121.4	0.76 (0.64, 0.89)	
							181.0	0.76 (0.64, 0.89)	
						All fruits	87.0 g/d	1.00	
							170.4	0.76 (0.65, 0.88)	
							239.4	0.79 (0.67, 0.92)	
							315.0	0.87 (0.74, 1.02)	
							483	1.05 (0.90, 1.23)	
						Citrus fruit	2.5 g/d	1.00	
							10.0	0.84 (0.72, 0.98)	
							16.7	0.84 (0.72, 0.98)	
							25.2	0.81 (0.69, 0.95)	
							44.4	1.11 (0.95, 1.29)	
						Watermelon	29.6 g/d	1.00	
							71.3	0.84 (0.72, 0.98)	
							109.7	0.83 (0.71, 0.97)	
							149.1	0.90 (0.77, 1.05)	
							221.0	1.04 (0.89, 1.21)	
						Other fruit	27.6 g/d	1.00	
							67.2	0.77 (0.66, 0.90)	
							102.2	0.68 (0.58, 0.80)	
							142.7	0.85 (0.73, 0.99)	

							217.6	0.90 (0.77, 1.05)	
de Koning L et al, 2011, USA	Health Professionals Follow-up Study (HPFS)	1986-2006, 20 years follow-up	51 529 men, age 40-75 years, 2680 cases	Validated semi-quantitative FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Fruit punches, lemonades, other noncarbonated fruit drinks	Per 1 serv/d	1.05 (0.89, 1.25)	Age, smoking, physical activity, alcohol intake, multivitamin use, family history of type 2 diabetes, high triglycerides (in 1986), high blood pressure, and use of diuretics
Cooper AJ et al, 2012, UK	EPIC-InterAct Study	1991-2007, 11 years follow-up	Sub-cohort: 14 800 participants, age 40-79 years, 10 821 cases	Country-specific, validated dietary questionnaires	Self-reported/ registers/drug registers/ hospital admissions/ mortality data	Total fruit and vegetables Total fruit Citrus fruit Non-citrus fruit Total vegetable	<235.7 g/d ≥235.7 - <369.1 ≥369.1 - <544.8 ≥544.8 <103.7 g/d ≥103.7 - <193.4 ≥193.4 - <315.9 ≥315.9 <10.1 g/d ≥10.1 - <35.9 ≥35.9 - <79.4 ≥79.4 <53.0 g/d ≥53.0 - <120.9 ≥120.9 - <213.5 ≥213.5 <100.5 g/d ≥100.5 - <154.8 ≥154.8 - <237.6 ≥237.6 <3.2 g/d	1.00 0.92 (0.83, 1.03) 0.93 (0.84, 1.03) 0.90 (0.80, 1.01) 1.00 0.92 (0.83, 1.03) 0.94 (0.83, 1.05) 0.89 (0.76, 1.04) 1.00 0.96 (0.86, 1.07) 1.00 (0.90, 1.10) 1.01 (0.86, 1.19) 1.00 1.02 (0.92, 1.13) 0.97 (0.87, 1.08) 0.94 (0.79, 1.13) 1.00 0.92 (0.84, 1.01) 0.93 (0.83, 1.05) 0.94 (0.84, 1.05) 1.00	Country, age, centre, sex, education, BMI, physical activity, smoking, total energy intake and alcohol intake Total fruit: additionally adjusted for total vegetable intake Citrus-and non-citrus fruit: adjusted for other fruit sub-types Non-citrus fruit: Umea (Sweden) excluded (no info)

						Green leafy vegetables Fruiting vegetables Root vegetables Cabbages Onion & garlic Stalk vegetables, sprouts Other vegetables	≥3.2 - <14.1 ≥14.1 - <37.7 ≥37.7 <28.6 g/d ≥28.6 - <50.5 ≥50.5 - <87.1 ≥87.1 <3.9 g/d ≥3.9 - <11.1 ≥11.1 - <27.3 ≥27.3 <1.5 g/d ≥1.5 - <8.5 ≥8.5 - <21.4 ≥21.4 <2.6 g/d ≥2.6 - <7.0 ≥7.0 - <17.7 ≥17.7 <0.2 g/d ≥0.2 - <3.8 ≥3.8 - <9.8 ≥9.8 <3.4 g/d ≥3.4 - <10.2 ≥10.2 - <23.0 ≥23.0	0.74 (0.65, 0.84) 0.75 (0.65, 0.86) 0.84 (0.65, 1.07) 1.00 0.94 (0.86, 1.04) 0.96 (0.86, 1.06) 0.97 (0.85, 1.12) 1.00 0.98 (0.88, 1.08) 0.85 (0.76, 0.95) 0.87 (0.77, 0.99) 1.00 0.94 (0.74, 1.19) 0.93 (0.80, 1.07) 0.90 (0.75, 1.09) 1.00 0.94 (0.75, 1.18) 0.88 (0.71, 1.10) 0.92 (0.63, 1.33) 1.00 0.91 (0.70, 1.18) 0.78 (0.68, 0.91) 0.82 (0.63, 1.07) 1.00 1.01 (0.87, 1.19) 0.90 (0.78, 1.04) 0.96 (0.76, 1.22)	Total vegetables: additionally adjusted for total fruit intake Green leafy vegetables, cabbages, onion and garlic, stalk vegetables and sprouts, other vegetables: Umea (Sweden) excluded (no info) Green leafy vegetable: Denmark excluded from analysis as there was not enough information to calculate HRs and 95% CIs Onion and garlic: France excluded (no info)
Elwood P et al, 2013, UK	Caerphilly Cohort Study (CaPS)	1979-2009, 30 years follow-up	2235 men, age 45-59 years, 214 cases	FFQ	Self-reported, validated by medical records	Fruit and vegetables	3 + vs. <3 serv/d	0.91 (0.62, 1.33)	Age and social class
Eshak ES et al, 2013, Japan	Japan Public Health Center-based Prospective Study (JPHC)	1990-1995 to 1990-2000, 10 years follow-up	27 585 participants, (12 137 men, 15 448 women), age 40-59 years, 824 cases (484	Validated FFQ, 44 items	Self-reported, validated by medical records	100% fruit juice 100% fruit juice	Rarely ≤2 times/wk 3-4 times/wk Almost every day Rarely ≤2 times/wk 3-4 times/wk Almost every day	1.00 0.81 (0.65, 1.01) 0.93 (0.65, 1.35) 1.17 (0.69, 2.00) 1.00 0.94 (0.73, 1.21) 0.90 (0.58, 1.40) 1.37 (0.79, 2.37)	Age, BMI, family history of diabetes, education, occupation, smoking status, alcohol, history of hypertension, physical activity,

			men, 340 women)			Vegetable juice Vegetable juice	Rarely ≤2 times/wk 3-4 times/wk Almost every day Rarely ≤2 times/wk 3-4 times/wk Almost every day	1.00 0.84 (0.65, 1.09) 0.81 (0.49, 1.39) 1.27 (0.65, 2.51) 1.00 0.97 (0.69, 1.35) 0.92 (0.47, 1.79) 0.71 (0.28, 1.82)	coffee, green tea, energy-adjusted intakes of dietary magnesium, calcium, vitamin D, rice and total dietary fiber, and total energy intake
Fagherazzi G et al, 2013, France	Etude Epide ´miologique aupre `s des femmes de la Mutuelle Ge ´ne ´rale de l'Education Nationale–European Prospective Investigation into Cancer and Nutrition cohort (E3N)	1993-2007, 14 years follow-up	66 118 women, age 40-65 years, 1369 cases	Validated diet-history questionnaire, 208 items	Self-reported/ a diabetes diet plan/ the use of diabetic drugs/ a hospitalization for diabetes, validated by drug registries or supplementary questionnaire	100% fruit juice	Non-consumers <180 180–447 mL/wk 448–967 mL/wk >967 mL/wk	1.00 0.90 (0.76, 1.07) 0.95 (0.81, 1.12) 1.18 (1.01, 1.38) 0.93 (0.78, 1.10)	Age, years of education, smoking, physical activity, hypertension, hypercholesterolemia, use of hormone replacement therapy, family history of diabetes, self-reported use of antidiabetic drugs, alcohol, omega-3 fatty acid intake, carbohydrate, coffee, fruit and vegetables, and processed-meat consumption, dietary pattern, total energy intake and BMI
Jacques PF et al, 2013, USA	Framingham Heart Study Offspring (FHSO)	1991-2008, 11.9 years follow-up	2 915 participants, age 10-70 years, 308 cases	Semi-quantitative FFQ, 145 items	Fasting glucose concentrations and/or a medical and medication use history	Apples and pears Banana	<138 g/wk 138-620 621-896 ≥897 <114 g/wk 114-512 513-740 ≥741	1.00 0.99 (0.67, 1.46) 0.63 (0.31, 1.26) 0.73 (0.35, 1.56) 1.00 1.16 (0.78, 1.73) 1.06 (0.59, 1.89) 1.36 (0.76, 2.43)	Sex, time-dependent variables age, cardiovascular disease, current smoker, BMI, cumulative mean energy intake
Kurotani K et al, 2013, Japan	Japan Public Health Center-based	1995-1998 to 2000-2003, 5	48 437 men and women (21 269	Validated self-administered FFQ, 147 items	Self-reported, validated by	Total vegetable and fruit intake (men)	146 g/d 273.1 414.1	1.00 0.85 (0.66, 1.10) 1.08 (0.83, 1.40)	Age, public health centre area, BMI, smoking, alcohol

	Prospective Study (JPHC)	years follow-up	men, 27 168 women), age 45-75 years, 896 cases (530 men, 366 women)		medical records		686.8	0.93 (0.67, 1.29)	consumption, leisure-time activity, history of hypertension, coffee consumption, family history of diabetes, magnesium intake, calcium intake, energy intake
						Total vegetable and fruit intake (women)	209.7 g/d	1.00	
							365.7	0.94 (0.69, 1.28)	
							532.9	0.79 (0.56, 1.11)	
							858.7	1.04 (0.69, 1.55)	
						Total vegetable intake (men)	75.2 g/d	1.00	
							141.7	0.93 (0.73, 1.19)	
							213.1	0.92 (0.70, 1.20)	
							355.4	0.81 (0.59, 1.13)	
						Total vegetable intake (women)	99.5 g/d	1.00	
							172.7	1.04 (0.77, 1.41)	
							252.5	0.76 (0.54, 1.08)	
							406.9	0.99 (0.66, 1.47)	
						Total fruit intake (men)	36.4 g/d	1.00	
							113.1	0.94 (0.73, 1.19)	
							191.6	0.91 (0.70, 1.18)	
							362.4	0.94 (0.71, 1.26)	
						Total fruit intake (women)	74.4 g/d	1.00	
							166.3	0.73 (0.53, 1.00)	
							272.2	0.96 (0.70, 1.32)	
							487.1	1.04 (0.73, 1.48)	
						Total green and yellow vegetables (men)	24.7 g/d	1.00	
							58.8	0.82 (0.64, 1.06)	
							94.6	1.05 (0.82, 1.36)	
							172.4	0.90 (0.66, 1.22)	
						Total green and yellow vegetables (women)	35.4 g/d	1.00	
							70.9	1.06 (0.79, 1.42)	
							113.2	0.84 (0.61, 1.17)	
							197.5	0.89 (0.61, 1.29)	
						Green leafy vegetables (men)	4.5 g/d	1.00	
							11.8	0.92 (0.72, 1.17)	
							22.7	0.88 (0.68, 1.14)	
							47.2	0.83 (0.62, 1.12)	
						Green leafy vegetables (women)	7.4 g/d	1.00	
							16.7	0.81 (0.60, 1.10)	
							29.5	0.88 (0.65, 1.20)	
							57.5	0.81 (0.57, 1.16)	
						Cruciferous vegetables (men)	17.6 g/d	1.00	
							37.3	1.02 (0.80, 1.30)	
							60.8	0.94 (0.73, 1.22)	

							103.9	0.78 (0.58, 1.06)	
						Cruciferous vegetables (women)	24.0 g/d	1.00	
							47.6	1.09 (0.80, 1.48)	
							72.5	1.13 (0.82, 1.55)	
							119.8	1.10 (0.77, 1.57)	
						Citrus fruits (men)	7.2 g/d	1.00	
							46.5	1.00 (0.79, 1.28)	
							79.3	0.85 (0.65, 1.10)	
							165.4	1.04 (0.79, 1.36)	
						Citrus fruits (women)	19.1 g/d	1.00	
							66.0	0.91 (0.67, 1.23)	
							114.8	0.92 (0.67, 1.27)	
							248.9	1.14 (0.82, 1.58)	
Muraki I et al, 2013, USA	Nurses' Health Study (NHS)	1984-2008, 21 years follow-up	66 105 women, age 30-55 years, 6358 cases	Validated semi-quantitative FFQ, 116 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Total whole fruit consumption	<4 serv/wk	1.00	Age, ethnicity, BMI, smoking, multivitamin use, physical activity, family history of diabetes, menopausal status and post-menopausal hormone use, oral contraceptive use, total energy intake, fruit juice consumption and modified alternate healthy eating index score. Individual fruit consumption was mutually adjusted
							5-6	0.92 (0.85, 0.99)	
							1 serv/d	0.96 (0.80, 0.93)	
							2	0.86 (0,79, 0.93)	
							≥3	0.90 (0.81, 0.99)	
							Every 3 serv/wk	0.98, 0.96, 1.00)	
						Grapes and raisins	<1 serv/mo	1.00	
							1-3	0.91 (0.86, 0.97)	
							1 serv/wk	0.88 (0.80, 0.95)	
							2-4	0.80 (0.72, 0.88)	
							≥5	0.77 (0.64, 0.92)	
							Every 3 serv/wk	0.84 (0.78, 0.91)	
						Peaches, plums and apricots	<1 serv/mo	1.00	
							1-3	0.99 (0.93, 1.07)	
							1 serv/wk	1.00 (0.92, 1.08)	
							2-4	1.04 (0.94, 1.14)	
							≥5	0.92 (0.78, 1.09)	
							Every 3 serv/wk	1.00 (0.93, 1.07)	
						Prunes	<1 serv/mo	1.00	
							1-3	0.99 (0.92, 1.07)	
							1 serv/wk	0.86 (0.73, 1.02)	
							2-≥5	0.89 (0.75, 1.06)	
							Every 3 serv/wk	0.87 (0.74, 1.03)	
						Bananas	<1 serv/mo	1.00	
							1-3	1.08 (0.98, 1.19)	
							1 serv/wk	1.05 (0.95, 1.17)	
							2-4	1.04 (0.94, 1.15)	

							≥5	1.08 (0.96, 1.21)	
							Every 3 serv/wk	1.01 (0.96, 1.06)	
						Cantaloupe	<1 serv/mo	1.00	
							1-3	1.00 (0.93, 1.08)	
							1 serv/wk	1.06 (0.98, 1.15)	
							2-≥5	1.07 (0.96, 1.19)	
							Every 3 serv/wk	1.08 (0.98, 1.18)	
						Apples and pears	<1 serv/mo	1.00	
							1-3	0.94 (0.84, 1.04)	
							1 serv/wk	0.94 (0.84, 1.05)	
							2-4	0.85 (0.77, 0.95)	
							≥5	0.82 (0.73, 0.92)	
							Every 3 serv/wk	0.91 (0.87, 0.95)	
						Oranges	<1 serv/mo	1.00	
							1-3	0.96 (0.89, 1.04)	
							1 serv/wk	1.03 (0.94, 1.13)	
							2-4	0.96 (0.87, 1.05)	
							≥5	1.03 (0.92, 1.15)	
							Every 3 serv/wk	1.00 (0.95, 1.06)	
						Grapefruit	<1 serv/mo	1.00	
							1-3	0.91 (0.85, 0.97)	
							1 serv/wk	0.95 (0.88, 1.03)	
							2-4	0.88 (0.80, 0.96)	
							≥5	0.86 (0.75, 0.98)	
							Every 3 serv/wk	0.92 (0.87, 0.98)	
						Total berries	<1 serv/mo	1.00	
							1-3	0.93 (0.86, 1.01)	
							1 serv/wk	0.95 (0.87, 1.03)	
							2-4	0.91 (0.82, 0.99)	
							≥5	0.96 (0.83, 1.11)	
							Every 3 serv/wk	0.97 (0.91, 1.03)	
						Strawberries	<1 serv/mo	1.00	
							1-3	0.94 (0.87, 1.01)	
							1 serv/wk	0.98 (0.90, 1.07)	
							2-4	0.87 (0.77, 0.98)	
							≥5	0.99 (0.79, 1.25)	
							Every 3 serv/wk	0.94 (0.85, 1.03)	
						Blueberries	<1 serv/mo	1.00	
							1-3	0.90 (0.85, 0.96)	
							1 serv/wk	0.89 (0.82, 0.98)	

							2-≥5	0.82 (0.69, 0.98)	
							Every 3 serv/wk	0.77 (0.66, 0.91)	
						Fruit juice	<1 serv/wk	1.00	
							1	1.09 (0.98, 1.21)	
							2-4	1.13 (1.03, 1.23)	
							5-6	1.13 (1.03, 1.24)	
							≥1 serv/d	1.21 (1.12, 1.31)	
							Per 3 serv/wk	1.07 (1.04, 1.11)	
Muraki I et al, 2013, USA	Nurses' Health Study II (NHS II)	1991-2009, 20 years follow-up	85 104 women, age 25-42 years, 3153 cases	Validated semi-quantitative FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998)	Total whole fruit consumption	<4 serv/wk	1.00	Age, ethnicity, BMI, smoking, multivitamin use, physical activity, family history of diabetes, menopausal status and post-menopausal hormone use, oral contraceptive use, total energy intake, fruit juice consumption and modified alternate healthy eating index score. Individual fruit consumption was mutually adjusted
							5-6	0.86 (0.77, 0.95)	
							1 serv/d	0.84 (0.76, 0.94)	
							2	0.88 (0.78, 0.98)	
							≥3	0.92 (0.78, 1.08)	
							Every 3 serv/wk	0.99 (0.96, 1.00)	
						Grapes and raisins	<1 serv/mo	1.00	
							1-3	0.81 (0.74, 0.88)	
							1 serv/wk	0.85 (0.75, 0.96)	
							2-4	0.83 (0.72, 0.97)	
							≥5	0.88 (0.66, 1.16)	
							Every 3 serv/wk	0.91 (0.81, 1.02)	
						Peaches, plums and apricots	<1 serv/mo	1.00	
							1-3	1.07 (0.97, 1.18)	
							1 serv/wk	1.03 (0.91, 1.16)	
							2-4	0.99 (0.86, 1.14)	
							≥5	1.01 (0.78, 1.31)	
							Every 3 serv/wk	0.97 (0.87, 1.08)	
						Prunes	<1 serv/mo	1.00	
							1-3	0.85 (0.75, 0.96)	
							1 serv/wk	1.00 (0.77, 1.31)	
							2-≥5	1.16 (0.88, 1.53)	
							Every 3 serv/wk	1.03 (0.79, 1.34)	
						Bananas	<1 serv/mo	1.00	
							1-3	0.95 (0.84, 1.07)	
							1 serv/wk	0.95 (0.83, 1.08)	
							2-4	0.82 (0.72, 0.94)	
							≥5	0.80 (0.67, 0.94)	
							Every 3 serv/wk	0.87 (0.81, 0.94)	
						Cantaloupe	<1 serv/mo	1.00	
							1-3	0.99 (0.90, 1.09)	
							1 serv/wk	1.05 (0.94, 1.17)	

							2-≥5	1.11 (0.94, 1.30)	
							Every 3 serv/wk	1.12 (0.96, 1.32)	
						Apples and pears	<1 serv/mo	1.00	
							1-3	0.83 (0.72, 0.95)	
							1 serv/wk	0.83 (0.72, 0.96)	
							2-4	0.79 (0.68, 0.91)	
							≥5	0.76 (0.64, 0.90)	
							Every 3 serv/wk	0.92 (0.86, 0.99)	
						Oranges	<1 serv/mo	1.00	
							1-3	0.94 (0.85, 1.04)	
							1 serv/wk	0.93 (0.82, 1.05)	
							2-4	0.93 (0.81, 1.07)	
							≥5	0.97 (0.78, 1.21)	
							Every 3 serv/wk	0.99 (0.89, 1.09)	
						Grapefruit	<1 serv/mo	1.00	
							1-3	1.00 (0.91, 1.09)	
							1 serv/wk	1.06 (0.94, 1.20)	
							2-4	0.97 (0.83, 1.14)	
							≥5	0.91 (0.69, 1.21)	
							Every 3 serv/wk	0.97 (0.86, 1.09)	
						Total berries	<1 serv/mo	1.00	
							1-3	0.93 (0.84, 1.05)	
							1 serv/wk	0.93 (0.82, 1.05)	
							2-4	0.92 (0.80, 1.05)	
							≥5	1.03 (0.86, 1.24)	
							Every 3 serv/wk	1.02 (0.94, 1.11)	
						Strawberries	<1 serv/mo	1.00	
							1-3	0.97 (0.87, 1.08)	
							1 serv/wk	1.01 (0.89, 1.15)	
							2-4	1.09 (0.93, 1.27)	
							≥5	1.08 (0.81, 1.43)	
							Every 3 serv/wk	1.09 (0.97, 1.22)	
						Blueberries	<1 serv/mo	1.00	
							1-3	0.83 (0.76, 0.91)	
							1 serv/wk	0.90 (0.79, 1.04)	
							2-≥5	0.69 (0.55, 0.87)	
							Every 3 serv/wk	0.67 (0.54, 0.83)	
						Fruit juice	<1 serv/wk	1.00	
							1	0.92 (0.81, 1.05)	
							2-4	0.97 (0.87, 1.00)	

							5-6 ≥1 serv/d Per 3 serv/wk	0.97 (0.86, 1.09) 1.14 (1.02, 1.27) 1.07 (1.02, 1.11)	
Muraki I et al, 2013, USA	Health Professionals Follow-up Study (HPFS)	1986-2008, 22 years follow-up	36 173 men, age 40-75 years, 2687 cases	Validated semi-quantitative FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Total whole fruit consumption	<4 serv/wk 5-6 1 serv/d 2 ≥3 Every 3 serv/wk	1.00 1.00 (0.88, 1.12) 0.92 (0.82, 1.03) 0.89 (0.79, 1.01) 0.90 (0.78, 1.04) 0.98 (0.95, 1.00)	Age, ethnicity, BMI, smoking, multivitamin use, physical activity, family history of diabetes, total energy intake, fruit juice consumption and modified alternate healthy eating index score. Individual fruit consumption was mutually adjusted
						Grapes and raisins	<1 serv/mo 1-3 1 serv/wk 2-4 ≥5 Every 3 serv/wk	1.00 0.95 (0.87, 1.05) 0.95 (0.84, 1.08) 0.87 (0.76, 1.01) 0.84 (0.69, 1.04) 0.91 (0.82, 0.99)	
						Peaches, plums and apricots	<1 serv/mo 1-3 1 serv/wk 2-4 ≥5 Every 3 serv/wk	1.00 0.98 (0.88, 1.08) 1.03 (0.90, 1.18) 0.88 (0.75, 1.04) 0.75 (0.55, 1.04) 0.87 (0.77, 0.99)	
						Prunes	<1 serv/mo 1-3 1 serv/wk 2-≥5 Every 3 serv/wk	1.00 0.92 (0.80, 1.06) 0.83 (0.63, 1.10) 0.86 (0.66, 1.12) 0.82 (0.63, 1.07)	
						Bananas	<1 serv/mo 1-3 1 serv/wk 2-4 ≥5 Every 3 serv/wk	1.00 1.09 (0.95, 1.25) 1.01 (0.87, 1.18) 0.93 (0.80, 1.07) 0.86 (0.73, 1.01) 0.89 (0.83, 0.95)	
						Cantaloupe	<1 serv/mo 1-3 1 serv/wk 2-≥5 Every 3 serv/wk	1.00 1.15 (1.03, 1.27) 1.17 (1.03, 1.34) 1.19 (1.01, 1.40) 1.14 (0.98, 1.34)	
						Apples and pears	<1 serv/mo 1-3 1 serv/wk	1.00 0.91 (0.78, 1.06) 0.98 (0.83, 1.16)	

							2-4	0.91 (0.77, 1.07)	
							≥ 5	0.93 (0.78, 1.11)	
							Every 3 serv/wk	0.98 (0.92, 1.06)	
						Oranges	<1 serv/mo	1.00	
							1-3	0.89 (0.79, 1.01)	
							1 serv/wk	0.91 (0.79, 1.04)	
							2-4	0.89 (0.78, 1.03)	
							≥5	0.89 (0.76, 1.05)	
							Every 3 serv/wk	0.97 (0.90, 1.05)	
						Grapefruit	<1 serv/mo	1.00	
							1-3	1.03 (0.93, 1.14)	
							1 serv/wk	1.09 (0.96, 1.24)	
							2-4	0.93 (0.81, 1.06)	
							≥5	1.08 (0.90, 1.30)	
							Every 3 serv/wk	0.99 (0.91, 1.08)	
						Total berries	<1 serv/mo	1.00	
							1-3	0.93 (0.83, 1.03)	
							1 serv/wk	0.95 (0.84, 1.07)	
							2-4	0.94 (0.81, 1.09)	
							≥5	1.22 (0.98, 1.52)	
							Per 3 serv/wk	1.24 (1.08, 1.42)	
						Strawberries	<1 serv/mo	1.00	
							1-3	0.95 (0.85, 1.05)	
							1 serv/wk	0.98 (0.85, 1.13)	
							2-4	1.16 (0.95, 1.42)	
							≥5	1.51 (1.00, 2.28)	
							Every 3 serv/wk	1.22 (1.03, 1.43)	
						Blueberries	<1 serv/mo	1.00	
							1-3	0.94 (0.85, 1.03)	
							1 serv/wk	0.96 (0.80, 1.15)	
							2-≥5	0.74 (0.55, 1.00)	
							Every 3 serv/wk	0.75 (0.58, 0.98)	
						Fruit juice	<1 serv/wk	1.00	
							1	1.07 (0.91, 1.26)	
							2-4	0.99 (0.86, 1.13)	
							5-6	1.05 (0.92, 1.20)	
							≥1 serv/d	1.13 (1.01, 1.27)	
							Per 3 serv/wk	1.06 (1.01, 1.11)	

Romaguera D et al, 2013, UK	EPIC-InterAct Study	1991-2007, 11.7 years follow-up	Sub-cohort: 15 374 participants, age 40-79, 11 684 cases	Country-specific validated dietary questionnaires	Self-report, validated by linkage to primary-care registers, secondary-care registers, medication use (drug registers), hospital admissions and mortality data	Juices and nectar	0.0 g/d 17.1 100.0 338.3	1.00 0.97 (0.86, 1.10) 1.04 (0.96, 1.13) 1.06 (0.90, 1.25)	Sex, educational level, physical activity, smoking status, alcohol consumption; juices and total soft drinks were mutually adjusted; sugar-sweetened and artificially sweetened soft drinks were also mutually adjusted plus adjustment for juice consumption, energy intake and BMI
Mursu J et al, 2014, Finland	Kuopio Ischaemic Heart Disease Risk Factor Study (KIHD)	1984-1989 to 2006-2008, 19.3 years follow-up	2332 men, age 42-60 years, 432 cases	Instructed 4-day food recording	Self-reported, diabetes register, blood glucose measurements and OGTT	Total fruit and vegetables Fruit Berries Fruit and berry juices Vegetables Cruciferous vegetable	90.94 g/d 192.50 284.80 469.26 0.71 g/d 33.82 99.13 241.25 0.00 g/d 14.68 41.04 108.55 0.00 g/d 39.03 128.21 387.25 36.29 g/d 82.73 128.18 231.92 0.00 g/d 3.76 14.28	1.00 0.79 (0.60, 1.03) 0.89 (0.68, 1.16) 0.76 (0.57, 1.02) 1.00 0.95 (0.72, 1.25) 0.87 (0.66, 1.15) 0.98 (0.75, 1.29) 1.00 1.15 (0.90, 1.47) 0.89 (0.68, 1.17) 0.65 (0.49, 0.88) 1.00 1.07 (0.82, 1.39) 1.03 (0.78, 1.34) 0.99 (0.74, 1.31) 1.00 0.90 (0.69, 1.17) 0.92 (0.70, 1.20) 0.81 (0.61, 1.07) 1.00 1.15 (0.89, 1.49) 0.89 (0.67, 1.76)	Age, examination years, BMI, WHR, smoking, education, leisure time physical activity, family history of diabetes, intake of energy, alcohol

							43.95	0.79 (0.59, 1.05)	
Qiao Y et al, 2014, USA	Women's Health Initiative (WHI)	1993-2005, 7.6 years follow-up	154 493 participants, age 50-79 years, 10 307 cases	Validated FFQ, 122 items	Self-reported, validated by medication and laboratory data	Vegetables	<3.01 serv/d ≥3.01	1.00 1.10 (0.96, 1.26)	Age, education, cigarette smoking, BMI, WHR, physical activity, log (daily energy intake), family history of diabetes, study arms and hormone therapy use
Lacoppidan SA et al, 2015, Denmark	Diet, Cancer, and Health cohort (DCH)	1993-2011, 15.3 years follow-up	55 060 participants (28 953 women, 26 107 men), age 50-64 years, 7366 cases (3269 women, 4097 men)	Validated FFQ, 192-items	Linkage to National Diabetes Registry	Apples and pears (women) Apples and pears (men)	<70.99 g/d ≥71 <55.99 g/d ≥56	1.00 1.03 (0.96, 1.11) 1.00 0.97 (0.91, 1.04)	Age, schooling level, participation in sports, smoking status, alcohol intake, red and processed meat, total energy intake, BMI and waist circumference
Muraki I et al, 2016, USA	Nurses' Health Study (NHS)	1984-2010, 22.4 years follow-up	70 773 women, age 30-55 years, 7436 cases	Validated semi-quantitative FFQ, 116 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Potatoes	<1 serv/wk 1 2-4 5-6 ≥7 Every 3 serv/wk	1.00 1.08 (0.93, 1.26) 1.15 (1.00, 1.32) 1.22 (1.05, 1.40) 1.27 (1.04, 1.56) 1.08 (1.04, 1.13)	Age, ethnicity, smoking status, alcohol intake, multivitamin use, physical activity, a family history of diabetes, menopausal status and postmenopausal hormone use, oral contraceptive use, total energy intake, modified aHEI score and baseline BMI

Muraki I et al, 2016, USA	Nurses' Health Study II (NHS II)	1991-2011, 18.4 years follow-up	87 739 women, age 25-42 years, 4621 cases	Validated semi-quantitative FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998).	Potatoes	<1 serv/wk 1 2-4 5-6 ≥7 Every 3 serv/wk	1.00 0.95 (0.78, 1.16) 0.99 (0.82, 1.19) 1.09 (0.90, 1.31) 1.38 (1.08, 1.76) 1.12 (1.05, 1.18)	Age, ethnicity, smoking status, alcohol intake, multivitamin use, physical activity, family history of diabetes, menopausal status and postmenopausal hormone use, oral contraceptive use, total energy intake, modified aHEI score and baseline BMI
Muraki I et al, 2016, USA	Health Professionals Follow-up Study (HPFS)	1986-2010, 19.5 years follow-up	40 669 men, age 40-75 years, 3305 cases	Validated semi-quantitative FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Potatoes	<1 serv/wk 1 2-4 5-6 ≥7 Every 3 serv/wk	1.00 0.94 (0.76, 1.17) 1.03 (0.85, 1.24) 1.09 (0.89, 1.32) 1.38 (1.07, 1.78) 1.10 (1.03, 1.17)	Age, ethnicity, smoking status, alcohol intake, multivitamin use, physical activity, a family history of diabetes, total energy intake, modified aHEI score and baseline BMI
Muraki et al, 2016, USA	Nurses' Health Study (NHS)	1984-2010, 21 years follow-up	70 773 women, age 30-55 years, 7436 cases 87 739	Validated semi-quantitative FFQ, 116 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997)	Baked, boiled or mashed potatoes (pooled)	Almost never to 1-3 serv/mo 1 serv/wk 2-4 ≥5 Every 3 serv/wk Almost never	1.00 1.02 (0.95, 1.09) 1.03 (0.96, 1.10) 1.08 (1.00, 1.16) 1.04 (1.01, 1.08) 1.00	Age, ethnicity, smoking status, alcohol intake, multivitamin use, physical activity, a family history of diabetes,

	Nurses' Health Study II (NHS II) Health Professionals Follow-up Study (HPFS)	1991-2011, 18.4 years follow-up 1986-2010, 19.5 years follow-up Median follow-up 20.0 years	women, age 25-42 years, 4621 cases 40 669 men, age 40-75 years, 3305 cases	Validated semi-quantitative FFQ, 131 items Validated semi-quantitative FFQ, 131 items	or American Diabetes criteria (after 1998). In NHS and HPFS, questionnaire-confirmed diagnosis of T2D was reconfirmed by medical record review	French fries (pooled)	1-3 serv/mo 1 serv/wk 2-4 ≥5 Every 3 serv/wk	1.11 (1.06, 1.17) 1.17 (1.11, 1.24) 1.26 (1.18, 1.35) 1.32 (1.13, 1.55) 1.19 (1.13, 1.25)	menopausal status, postmenopausal hormone use, oral contraceptive use (NHS and NHS II), total energy intake, modified aHEI score, baked, boiled or mashed potatoes (for french fries), and french fries (for baked, boiled, or mashed potatoes) and baseline BMI
Alperet DJ et al, 2017, Singapore	Singapore Chinese Health Study (SCHS)	1993-2010, 10.9 years follow-up	45 411 participants, age 45-74 years, 5207 cases	Validated semi-quantitative FFQ, 165 items	Self-reported, validated by linkage with a nationwide hospital-based discharge database and supplementary questionnaire	Total whole-fruit (all) Total whole-fruit (men) Total whole-fruit (women) Temperate fruit (all) *apples,*	0.1 serv/wk 1.5 3.0 5.5 9.6 16.6 25.3 Per 3 serv/wk 0.0 serv/wk 1.5 3.0 5.5 9.7 16.7 25.5 Per 3 serv/wk 0.2 serv/wk 1.5 3.0 5.5 9.6 16.6 25.1 Per 3 serv/wk 0.0 serv/wk 0.5	1.00 1.10 (0.92, 1.30) 1.15 (1.00, 1.32) 1.11 (0.98, 1.27) 1.06 (0.93, 1.21) 1.08 (0.93, 1.25) 1.08 (0.91, 1.27) 0.99 (0.98, 1.01) 1.00 1.01 (0.75, 1.35) 1.24 (0.99, 1.56) 1.25 (1.00, 1.54) 1.16 (0.94, 1.43) 1.24 (0.99, 1.56) 1.33 (1.04, 1.71) 1.01 (0.99, 1.03) 1.00 1.14 (0.92, 1.41) 1.11 (0.93, 1.32) 1.04 (0.88, 1.23) 1.00 (0.85, 1.18) 0.97 (0.81, 1.17) 0.88 (0.71, 1.11) 0.97 (0.96, 0.99) 1.00	Age, sex, dialect group, year of baseline interview, total daily energy intake, physical activity, education, smoking, alcohol intake, BMI, total vegetable intake, unsweetened soy intake, saturated fat intake, dairy intake, soft drink consumption, coffee intake, black and green tea intake, fruit- and vegetable-juice intake, mutually adjusted for individual fruits Juice: adjusted for all the above, included dietary fiber, but not adjusted for fruit-

						pears, apricots, peaches, grapes, persimmon	1.3 2.9 5.0 8.1	0.95 (0.85, 1.06) 0.98 (0.88, 1.09) 0.96 (0.87, 1.05) 0.94 (0.83, 1.05)	and vegetable-juice intake
						Temperate fruit (men)	0.0 serv/wk 0.5 1.3 2.9 5.0 8.1	0.86 (0.77, 0.97) 1.00 0.99 (0.85, 1.16) 1.02 (0.87, 1.19) 1.03 (0.89, 1.19) 0.99 (0.83, 1.17)	
						Temperate fruit (women)	0.0 serv/wk 0.5 1.4 3.0 5.1 8.1	0.97 (0.82, 1.16) 1.00 0.91 (0.78, 1.05) 0.95 (0.82, 1.09) 0.90 (0.79, 1.03) 0.89 (0.76, 1.04)	
						Apple (all)	0.0 serv/wk 0.5 1.0 2.5 5.0 7.0 Per 3 serv/wk	0.79 (0.67, 0.92) 1.00 0.97 (0.89, 1.05) 0.93 (0.85, 1.02) 0.93 (0.86, 1.01) 0.90 (0.79, 1.03) 0.82 (0.74, 0.92)	
						Apple (men)	0.0 serv/wk 0.5 1.0 2.5 5.0 7.0 Per 3 serv/wk	0.93 (0.90, 0.97) 1.00 0.93 (0.81, 1.06) 0.98 (0.85, 1.12) 0.94 (0.83, 1.07) 0.94 (0.77, 1.14) 0.95 (0.80, 1.13)	
						Apple (women)	0.0 serv/wk 0.5 1.0 2.5 5.0 7.0 Per 3 serv/wk	0.98 (0.92, 1.04) 1.00 0.99 (0.88, 1.11) 0.91 (0.81, 1.02) 0.92 (0.83, 1.03) 0.87 (0.74, 1.03) 0.75 (0.64, 0.87)	
						Pear (all)	0.0 serv/wk 0.5 1.0	0.90 (0.86, 0.95) 1.00 0.99 (0.93, 1.06)	

							2.5	1.02 (0.94, 1.11)	
							Per 3 serv/wk	1.07 (0.97, 1.18	
						Pear (men)	0.0 serv/wk	1.08 (0.99, 1.19)	
							0.5	1.00	
							1.0	1.03 (0.93, 1.14)	
							2.5	1.01 (0.88, 1.14)	
							Per 3 serv/wk	1.05 (0.90, 1.23)	
						Pear (women)	0.0 serv/wk	1.07 (0.93, 1.23)	
							0.5	1.00	
							1.0	0.97 (0.89, 1.06)	
							2.5	1.04 (0.93, 1.15)	
							Per 3 serv/wk	1.09 (0.96, 1.23)	
						Grapes (all)	0.0 serv/wk	1.10 (0.97, 1.23)	
							0.3	1.00	
							1.3	0.95 (0.89, 1.01)	
							2.0	0.98 (0.88, 1.08)	
							Per 3 serv/wk	0.86 (0.75, 0.99)	
						Grapes (men)	0.0 serv/wk	0.87 (0.76, 0.99)	
							0.5	1.00	
							1.3	0.97 (0.88, 1.06)	
							2.0	1.02 (0.87, 1.19)	
							Per 3 serv/wk	0.81 (0.65, 1.01)	
						Grapes (women)	0.0 serv/wk	0.87 (0.71, 1.07)	
							0.3	1.00	
							1.3	0.94 (0.86, 1.02)	
							2.0	0.95 (0.83, 1.08)	
							Per 3 serv/wk	0.89 (0.75, 1.06)	
						Subtropical fruits	0.0 serv/wk	0.87 (0.73, 1.03)	
						(all)	0.5	1.00	
							1.1	0.97 (0.89, 1.06)	
							2.5	0.99 (0.90, 1.09)	
							5.1	1.01 (0.93, 1.09)	
							7.1	0.98 (0.88, 1.10)	
							Per 3 serv/wk	1.01 (0.90, 1.12)	
						Subtropical	0.0 serv/wk	1.00 (0.97, 1.04)	
						fruits (men)	0.5	1.00	
							1.1	0.96 (0.84, 1.11)	
							2.5	1.03 (0.89, 1.20)	
							5.1	1.07 (0.94, 1.22)	
							7.1		

						Subtropical fruits (women)	0.0 serv/wk	1.02 (0.85, 1.21)	
							0.5	1.07 (0.91, 1.26)	
							1.1	1.00	
							2.5	0.99 (0.88, 1.11)	
							5.1	0.97 (0.86, 1.09)	
							7.1	0.97 (0.87, 1.08)	
						Oranges (all)	0.0 serv/wk	0.96 (0.83, 1.12)	
							0.6	0.96 (0.84, 1.11)	
							1.0	1.00	
							2.5	0.96 (0.88, 1.05)	
							5.0	1.00 (0.92, 1.10)	
							7.0	1.01 (0.94, 1.09)	
							Per 3 serv/wk	1.07 (0.95, 1.21)	
						Oranges (men)	0.0 serv/wk	1.01 (0.91, 1.13)	
							0.6	1.02 (0.98, 1.06)	
							1.0	1.00	
							2.5	0.93 (0.81, 1.07)	
							5.0	1.02 (0.89, 1.18)	
							7.0	1.09 (0.96, 1.22)	
							Per 3 serv/wk	1.10 (0.92, 1.32)	
						Oranges (women)	0.0 serv/wk	1.05 (0.89, 1.23)	
							0.6	1.03 (0.98, 1.09)	
							1.0	1.00	
							2.5	0.99 (0.89, 1.12)	
							5.0	1.00 (0.89, 1.12)	
							7.0	0.98 (0.88, 1.08	
							Per 3 serv/wk	1.06 (0.90, 1.24)	
						Tangerine (all)	0.0 serv/wk	1.00 (0.87, 1.15)	
							0.1	1.01 (0.96, 1.06)	
							1.5	1.00	
							4.1	1.05 (0.99, 1.11)	
							Per 3 serv/wk	0.91 (0.77, 1.06)	
						Tangerine (men)	0.0 serv/wk	0.90 (0.79, 1.04)	
							0.1	0.90 (0.81, 1.00)	
							1.5	1.00	
							4.1	1.03 (0.94, 1.13)	
							Per 3 serv/wk	0.94 (0.73, 1.20)	
						Tangerine (women)	0.0 serv/wk	0.87 (0.70, 1.08)	
							0.1	0.90 (0.77, 1.05)	
							1.5	1.00	

							4.1	1.06 (0.98, 1.15)	
							Per 3 serv/wk	0.89 (0.72, 1.10)	
						Tropical fruit	0.0 serv/wk	0.90 (0.75, 1.08)	
						(all)	0.6	0.88 (0.77, 1.01)	
							1.4	1.00	
							2.8	1.02 (0.91, 1.16)	
							5.0	1.05 (0.93, 1.18)	
							10.0	1.05 (0.94, 1.17)	
						Tropical fruit	0.0 serv/wk	1.01 (0.89, 1.14)	
						(men)	0.6	1.08 (0.95, 1.22)	
							1.4	1.00	
							2.8	1.20 (0.97, 1.50)	
							5.0	1.12 (0.91, 1.38)	
							10.1	1.19 (0.98, 1.45)	
						Tropical fruit	0.0 serv/wk	1.16 (0.95, 1.41)	
						(women)	0.6	1.24 (1.01, 1.53)	
							1.4	1.00	
							2.8	0.95 (0.81, 1.10)	
							5.0	1.02 (0.88, 1.17)	
							9.5	0.98 (0.86, 1.13)	
						Banana (all)	0.0 serv/wk	0.94 (0.80, 1.10)	
							0.5	0.99 (0.83, 1.17)	
							1.0	1.00	
							2.5	0.99 (0.92, 1.07)	
							5.0	0.96 (0.89, 1.05)	
							7.0	0.96 (0.87, 1.05)	
							Per 3 serv/wk	1.04 (0.91, 1.19)	
						Banana (men)	0.0 serv/wk	1.09 (0.93, 1.29)	
							0.6	1.03 (0.98, 1.08)	
							1.0	1.00	
							2.5	1.13 (0.99, 1.28)	
							5.0	1.12 (0.98, 1.28)	
							7.0	1.06 (0.92, 1.23)	
							Per 3 serv/wk	1.19 (0.99, 1.43)	
						Banana (women)	0.0 serv/wk	1.49 (1.20, 1.84)	
							0.5	1.11 (1.04, 1.19)	
							1.0	1.00	
							2.5	0.93 (0.85, 1.03)	
							5.0	0.89 (0.80, 0.99)	
							7.0	0.91 (0.81, 1.03)	

							Per 3 serv/wk	0.96 (0.78, 1.18)	
						Papaya	0.0 serv/wk	0.77 (0.59, 1.01)	
							0.5	0.94 (0.87, 1.01)	
							1.0	1.00	
							2.5	1.00 (0.93, 1.07)	
							5.0	0.92 (0.85, 1.00)	
							Per 3 serv/wk	0.94 (0.85, 1.03)	
						Papaya (men)	0.0 serv/wk	0.89 (0.78, 1.02)	
							0.5	0.94 (0.88, 1.00)	
							1.0	1.00	
							2.5	1.01 (0.90, 1.13)	
							5.0	0.91 (0.80, 1.04)	
							Per 3 serv/wk	0.94 (0.81, 1.08)	
						Papaya	0.0 serv/wk	0.83 (0.68, 1.00)	
						(women)	0.5	0.91 (0.83, 1.00)	
							1.0	1.00	
							2.5	1.00 (0.91, 1.09)	
							5.0	0.93 (0.83, 1.03)	
							Per 3 serv/wk	0.94 (0.82, 1.07)	
						Watermelon (all)	0.0 serv/wk	0.97 (0.80, 1.17)	
							0.5	0.97 (0.88, 1.06)	
							1.0	1.00	
							2.5	1.05 (0.98, 1.12)	
							5.0	1.06 (0.97, 1.15)	
							Per 3 serv/wk	1.10 (0.98, 1.24)	
						Watermelon	0.0 serv/wk	1.10 (0.92, 1.32)	
						(men)	0.5	1.08 (0.98, 1.18)	
							1.0	1.00	
							2.5	1.05 (0.95, 1.17)	
							5.0	1.10 (0.97, 1.26)	
							Per 3 serv/wk	1.14 (0.97, 1.34)	
						Watermelon	0.0 serv/wk	1.17 (0.92, 1.49)	
						(women)	0.5	1.11 (0.98, 1.26)	
							1.0	1.00	
							2.5	1.05 (0.96, 1.14	
							5.0	1.02 (0.91, 1.15)	
							Per 3 serv/wk	1.08 (0.91, 1.28)	
						Honeydew melon	0.0 serv/wk	1.01 (0.76, 1.36)	
						(all)	0.3	1.05 (0.91, 1.20)	
							1.0	1.00	

							2.5	1.03 (0.97, 1.10)	
							Per 3 serv/wk	0.94 (0.85, 1.04)	
						Honeydew melon (men)	0.0 serv/wk	1.05 (0.92, 1.19)	
							0.3	1.02 (0.90, 1.16)	
							1.0	1.00	
							2.5	0.98 (0.89, 1.09)	
							Per 3 serv/wk	0.88 (0.76, 1.03)	
						Honeydew melon (women)	0.0 serv/wk	0.98 (0.82, 1.18)	
							0.3	0.92 (0.76, 1.10)	
							1.0	1.00	
							2.5	1.06 (0.98, 1.15)	
							Per 3 serv/wk	0.99 (0.87, 1.13)	
						Total juice (all)	0.0 serv/wk	1.10 (0.92, 1.32)	
							0.5	1.12 (0.94, 1.34)	
							1.0	1.00	
							2.5	1.03 (0.95, 1.12)	
							7.0	1.13 (1.04, 1.24)	
							Per 3 serv/wk	1.05 (0.93, 1.18)	
						Total juice (men)	0.0 serv/wk	1.16 (1.00, 1.34)	
							0.5	1.08 (1.02, 1.16)	
							1.0	1.00	
							2.5	1.09 (0.96, 1.23)	
							5.5	1.16 (1.03, 1.32)	
							Per 3 serv/wk	1.09 (0.93, 1.29)	
						Total juice (women)	0.0 serv/wk	1.15 (0.93, 1.41)	
							0.5	1.09 (1.00, 1.20)	
							1.0	1.00	
							2.5	0.99 (0.89, 1.11)	
							7.0	1.11 (0.99, 1.25)	
							Per 3 serv/wk	1.01 (0.86, 1.20)	
								1.16 (0.94, 1.42)	
								1.07 (0.98, 1.18)	
Auerbach BJ et al, 2017, USA	The Women's Health Initiative (WHI)	1993-1998 to 2005, 7.8 years follow-up	114 219 women, age 50-79 years, 11 488 cases	Validated semi-quantitative FFQ, 122 items	Self-reported, validated by medication inventory and fasting plasma glucose levels	100% fruit juice	≤4 serv/wk	1.00	Age, education level, race/ethnicity, smoking status, physical activity, body mass index, hormone replacement therapy status, study arm,
							5–6	1.01 (0.97, 1.07)	
							1 serv/d	0.97 (0.93, 1.02)	
							2–3	0.97 (0.87, 1.08)	
							≥4	0.82 (0.53, 1.27)	
						Whole fruit	≤4 serv/wk	1.00	
							5–6	1.03 (0.97, 1.08)	
							1 serv/d	1.00 (0.94, 1.06)	

						Citrus fruits	2–3 ≥4 <4 serv/wk 5-6 1 serv/d 2-3	1.04 (0.96, 1.11) 0.93 (0.73, 1.18) 1.00 0.93 (0.87, 0.99) 0.96 (0.85, 1.08) 0.98 (0.65, 1.47)	and total energy intake
Bahadoran Z et al, 2017, Iran	Tehran Lipid and Glucose Study (TLGS)	2006-2008 to 2012-2014, 6 years follow-up	3052 participants, age ≥19 years, 150 cases	Validated FFQ, 168 items	Fasting plasma glucose or medication use	Allium vegetables	1.0 g/wk 10 g/wk 39 g/wk Per each 10 g/wk	1.00 1.05 (0.69, 1.61) 0.86 (0.57, 1.31) 0.95 (0.91, 1.05)	Age, diabetes risk score, physical activity, and dietary pattern scores
Du H et al, 2017, China	The China Kadoorie Biobank Study (CKB)	2004-2008 to 2013-2014 7 years follow-up	482 591 participants, age 30-79 years, 9504 cases	Administered laptop-based questionnaire on diet	Linkage with local disease and death registries, health insurance databases	Fresh fruit consumption	Never/rarely Monthly 1-3 d/wk 4-6 d/wk Daily	1.00 0.99 (0.90, 1.09) 0.93 (0.84, 1.02) 0.93 (0.83, 1.04) 0.88 (0.83, 0.93)	Age, sex, region, education, income, alcohol, smoking, physical activity, survey season, BMI, family history of diabetes, dairy products, meat, preserved vegetables
Lv J et al, 2017, China	China Kadoorie Biobank (CKB)	2004-2008 to 2013, 7.2 years follow-up	461 211 participants, age 30-79 years, 8784 cases	Validated qualitative FFQ	Linkage with local disease and death registries	Vegetables and fruits	Less than daily (either or both) Daily (both)	1.00 0.91 (0.85, 0.97)	Age, sex, education, marital status, family history of diabetes, smoking, alcohol consumption, physical activity, red meat and wheat, BMI, WHR
Huang M et al, 2017, USA	The Women's Health Initiative (WHI)	1993-1998 to 2010, 8.4 years follow-up	64 850 women, age 50-79 years, 4675 cases	Validated semi-quantitative FFQ, 122 items	Self-report, validated by medical record review and laboratory data	Fruit drinks	<1 serv/wk 1 serv/wk - <1 serv/d ≥ 1 serv/d	1.00 0.99 (0.85, 1.15) 1.33 (0.89, 1.98)	Age, race, marital status, family income, education, family history of diabetes, BMI, change in BMI, WHR, systolic blood pressure, insurance status, antihypertensive

									use, antihyperlipidemic use, hormone replacement therapy use, calibrated energy, sugar-sweetened beverages, glycemic load, glycemic index, Alternate Healthy Eating Index, cardiovascular history, hysterectomy history, smoking status, physical activity, sitting time, alcohol consumption
Mamluk L, 2017, USA	The NIH-AARP Diet and Health Study (NIH-AARP)	1995-1996 to 2004-2006, 10.6 years follow-up	401 909 participants, age >50 years, 22 782 cases	Validated self-reported FFQ, 124-items	Self-administered questionnaires or in interviews	Fruit intake	0.82 portions/d 1.99 3.24 7.73 Total intake 1 portion/d	1.00 0.96 (0.91, 1.02) 0.95 (0.91, 0.99) 0.95 (0.91, 0.99) 1.00 (0.99, 1.01)	Age, sex, BMI, physical activity, energy intake, alcohol consumption, education, smoking
						Vegetable intake	1.04 portions/d 2.02 3.20 6.41 Total intake 1 portion/d	1.00 0.92 (0.87, 0.97) 0.88 (0.84, 0.94) 0.92 (0.87, 0.97) 1.00 (0.99, 1.01)	
						Leafy green vegetables	0.65 portions/wk 1.98 3.10 8.06 Total intake 1 portion/d	1.00 0.90 (0.86, 0.94) 0.89 (0.85, 0.94) 0.87 (0.84, 0.90) 0.98 (0.98, 0.99)	
						Cabbage	0.32 portions/wk 1.63	1.00 1.06 (1.01, 1.12)	

							3.90 9.79 Total intake 1 portion/d	1.09 (1.00, 1.18) 1.07 (0.94, 1.21) 1.02 (1.01, 1.03)	
Mamluk L, 2017, Greece	EPIC-elderly Greece	1994-ongoing, 10 years follow-up	7567 participants, age >50 years, 1077 cases	Validated FFQ, 200 items	Self-administered questionnaires or in interviews	Fruit intake	1.06 portions/d 2.08 3.28 5.29 Total intake 1 portion/d	1.00 1.12 (0.77, 1.64) 1.09 (0.77, 1.54) 1.09 (0.77, 1.55) 1.00 (0.96, 1.04)	Age, sex, BMI, physical activity, energy intake, alcohol consumption, education, smoking
						Vegetable intake	1.15 portions/d 2.12 3.39 5.61 Total intake 1 portion/d	1.00 1.96 (0.81, 4.77) 2.29 (0.99, 5.36) 2.15 (0.93, 5.03) 0.99 (0.95, 1.04)	
						Leafy green vegetables	0.87 portions/wk 2.13 3.13 6.18 Total intake 1 portion/d	1.00 1.23 (0.89, 1.71) 1.55 (1.14, 2.11) 1.52 (1.13, 2.04) 1.02 (0.99, 1.04)	
						Cabbage	0.84 portions/wk 2.06 3.06 4.88 Total intake 1 portion/d	1.00 0.93 (0.77, 1.11) 1.21 (1.07, 1.44) 1.09 (0.85, 1.41) 1.02 (0.98, 1.07)	
Chen GC et al, 2018, Singapore	Singapore Chinese Health Study (SCHS)	1993-2010, 10.9 years follow-up	45 411 participants, age 45-74 years, 5207 cases	Validated semi-quantitative FFQ, 165 items	Self-reported, validated by linkage with a nationwide hospital-based discharge database and supplementary questionnaire	Total vegetables	57.431 g/d 83.286 105.459 132.489 184.357	1.00 1.16 (1.06, 1.26) 0.98 (0.89, 1.07) 1.02 (0.93, 1.11) 1.08 (0.98, 1.18)	Age, sex, dialect group, year of baseline interview, energy intake, physical activity, education, smoking, alcohol, soft drink, coffee, energy-adjusted intakes of red meat, poultry, fish, nuts and seeds, soya products and
						Light green vegetables	14.181 g/d 22.094 28.989 37.608 55.001	1.00 0.99 (0.90, 1.08) 0.98 (0.90, 1.08) 1.02 (0.93, 1.11) 0.95 (0.87, 1.04)	
						Dark green leafy vegetables	13.946 g/d 23.505	1.00 0.96 (0.88, 1.04)	

							32.201	1.03 (0.94, 1.12)	wholegrains, BMI, history of hypertension
							43.484	0.96 (0.88, 1.05)	
							65.735	1.05 (0.96, 1.15)	
						Cruciferous vegetables	18.882 g/d	1.00	
							30.243	0.97 (0.89, 1.06)	
							40.428	1.02 (0.94, 1.12)	
							53.278	0.90 (0.82, 0.98)	
							79.211	0.97 (0.88, 1.06)	
						Yellow vegetables	0.938 g/d	1.00	
							3.525	0.94 (0.87, 1.03)	
							5.954	0.95 (0.87, 1.03)	
							9.480	1.05 (0.96, 1.14)	
							18.568	0.97 (0.88, 1.06)	
						Potatoes	0.023 g/d	1.00	
							1.802	1.02 (0.94, 1.11)	
							3.604	0.97 (0.89, 1.06)	
							5.876	1.02 (0.94, 1.11)	
							11.517	0.95 (0.87, 1.04)	
						Tomatoes	0.579 g/d	1.00	
							2.898	1.02 (0.93, 1.11)	
							5.249	1.08 (0.99, 1.18)	
							8.226	1.09 (1.00, 1.19)	
							17.315	1.06 (0.97, 1.16)	
						Preserved vegetables	1.488 g/d	1.00	
							3.839	0.91 (0.84, 1.00)	
							5.719	0.95 (0.87, 1.04)	
							8.461	0.99 (0.90, 1.08)	
							16.375	0.97 (0.89, 1.06)	
Farhadnejad H et al, 2018, Iran	Tehran Lipid and Glucose Study (TLGS)	2006-2008 to 2012-2014, 6 years follow-up	1981 participants, age 18-75 years, 132 cases	Validated FFQ, 168 items	Fasting plasma glucose levels (ADA criteria)	Total potato	7.30 g/d	1.00	Age, sex, BMI, physical activity, smoking, family history of diabetes, hypertension, serum triglycerides, high-density lipoprotein cholesterol, daily intakes of energy, saturated fat and food groups intake, including fruit,
							16.05	0.60 (0.34, 1.01)	
							29.22	0.75 (0.45, 1.26)	
							55.50	0.46 (0.25, 0.84)	
						Boiled potato	2.42 g/d	1.00	
							10.38	0.65 (0.39, 1.08)	
							20.76	0.74 (0.43, 1.28)	
							36.3	0.47 (0.26, 0.85)	
						Fried potato	1.30 g/d	1.00	
							4.66	0.82 (0.50, 1.35)	
							10.33	0.60 (0.35, 1.03)	
							25.71	0.50 (0.25, 1.07)	

									whole grains, vegetables, nuts and legumes
Khalili-Moghadam S et al, 2018, Iran	Tehran Lipid and Glucose Study (TLGS)	2006-2008 to 2012-2014, 5.8 years follow-up	2139 participants (1168 women, 971 men), age 20-70 years, 143 cases	Validated semi-quantitative FFQ, 168 items	Fasting plasma glucose levels	Vegetables Fruit	1.7 serv/d 2.6 3.8 2.1 serv/d 3.5 5.1	1.00 0.75 (0.48, 1.17) 0.89 (0.57, 1.39) 1.00 1.14 (0.74, 1.75) 0.75 (0.46, 1.22)	Diabetes risk score: family history of diabetes, FPG concentrations, SBP, WHtR and TG/HDL-C
Ma L et al, 2018, USA	The Nurses' Health Study (NHS)	1984-2012, 23.6 years follow-up	71 256 women, age 30-55 years, 7586 cases	Validated FFQ, 116 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Total cruciferous vegetables Broccoli Cabbage Cauliflower Brussel sprouts Kale, mustard or chard greens	<1 serv/wk 1-3 4-6 ≥1 serv/d Every 2 serv/wk <0.5 serv/wk 0.5-1 2-3 ≥4 Every 2 serv/wk Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk	1.00 1.14 (1.04, 1.25) 1.23 (1.11, 1.36) 1.22 (1.07, 1.38) 1.03 (1.01, 1.05) 1.00 1.03 (0.95, 1.11) 1.07 (1.00, 1.15) 0.92 (0.77, 1.09) 1.01 (0.96, 1.05) 1.00 1.12 (1.00, 1.24) 1.22 (1.09, 1.36) 1.25 (1.12, 1.39) 1.10 (1.04, 1.17) 1.00 0.99 (0.91, 1.08) 1.04 (0.96, 1.14) 1.07 (0.98, 1.17) 1.05 (0.99, 1.10) 1.00 1.08 (1.03, 1.14) 1.14 (1.06, 1.24) 1.27 (1.16, 1.40) 1.28 (1.16, 1.40) 1.00 1.03 (0.96, 1.10) 0.98 (0.84, 1.15) 1.04 (0.87, 1.24) 1.04 (0.89, 1.21)	Age, race/ethnicity, family history of diabetes, smoking status, alcohol intake, physical activity, menopausal status and postmenopausal hormone use, oral contraceptive use, multivitamin use, hypertension, hypercholesterolemia, BMI, total energy intake, the modified alternate healthy eating index score

Ma L et al, 2018, USA	The Nurses' Health Study II (NHS II)	1991-2013, 20.2 years follow-up	88 293 women, age 24-44 years, 5438 cases	Validated FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998)	Total cruciferous vegetables	<1 serv/wk	1.00	Age, race/ethnicity, family history of diabetes, smoking status, alcohol intake, physical activity, menopausal status and postmenopausal hormone use, oral contraceptive use, multivitamin use, hypertension, hypercholesterolemia, BMI, total energy intake, and the modified alternate healthy eating index score
							1-3	1.00 (0.93, 1.07)	
							4-6	1.10 (1.00, 1.20)	
							≥ 1 serv/d	1.10 (0.98, 1.24)	
							Every 2 serv/wk	1.02 (1.00, 1.04)	
						Broccoli	<0.5 serv/wk	1.00	
							0.5-1	0.91 (0.82, 1.01)	
							2-3	0.98 (0.92, 1.05)	
							≥4	1.06 (0.91, 1.23)	
							Every 2 serv/wk	1.00 (0.96, 1.04)	
						Cabbage	Never/almost never	1.00	
							<0.5 serv/wk	0.97 (0.91, 1.04)	
							0.5-1	0.95 (0.85, 1.07)	
							≥1	1.13 (1.04, 1.23)	
							Every 2 serv/wk	1.05 (0.99, 1.11)	
						Cauliflower	Never/almost never	1.00	
							<0.5 serv/wk	0.95 (0.88, 1.02)	
							0.5-1	0.91 (0.81, 1.02)	
							≥1	1.05 (0.98, 1.14)	
							Every 2 serv/wk	1.05 (1.00, 1.11)	
						Brussel sprouts	Never/almost never	1.00	
							<0.5 serv/wk	1.04 (0.97, 1.11)	
							0.5-1	1.09 (0.93, 1.27)	
							≥1	1.09 (0.98, 1.22)	
							Every 2 serv/wk	1.11 (1.01, 1.23)	
						Kale, mustard or chard greens	Never/almost never	1.00	
							<0.5 serv/wk	1.05 (0.95, 1.16)	
							0.5-1	1.20 (0.93, 1.54)	
							≥1	1.16 (0.97, 1.38)	
							Every 2 serv/wk	1.07 (1.00, 1.16)	
Ma L et al, 2018, USA	The Health Professionals Follow-up Study (HPFS)	1986-2012, 20.3 years follow-up	41 358 men, age 40-75 years, 3543 cases	Validated FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria	Total cruciferous vegetables	<1 serv/wk	1.00	Age, race/ethnicity, family history of diabetes, smoking status, alcohol intake, physical activity, multivitamin use, hypertension, hypercholesterolemia, BMI, total energy
							1-3	0.98 (0.88, 1.09)	
							4-6	1.04 (0.92, 1.18)	
							≥ 1 serv/d	1.17 (1.00, 1.36)	
							Every 2 serv/wk	1.03 (1.01, 1.06)	
						Broccoli	<0.5 serv/wk	1.00	
							0.5-1	1.07 (0.97, 1.19)	
							2-3	1.02 (0.93, 1.11)	
							≥4	1.38 (1.10, 1.72)	
							Every 2 serv/wk	1.03 (0.98, 1.09)	

					(after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Cabbage Cauliflower Brussel sprouts Kale, mustard or chard greens	Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk Never/almost never <0.5 serv/wk 0.5-1 ≥1 Every 2 serv/wk	1.00 0.99 (0.86, 1.13) 1.11 (0.94, 1.32) 1.09 (0.97, 1.23) 1.00 (0.99, 1.02) 1.00 0.92 (0.84, 1.02) 1.00 (0.89, 1.12) 1.01 (0.90, 1.12) 1.04 (0.96, 1.13) 1.00 1.01 (0.94, 1.09) 1.11 (0.98, 1.25) 1.16 (1.03, 1.31) 1.11 (1.00, 1.24) 1.00 1.04 (0.95, 1.14) 1.07 (0.88, 1.30) 1.09 (0.90, 1.31) 1.08 (0.94, 1.24)	intake, and the modified alternate healthy eating index score
Dow C et al, 2019, Australia	The Australian Diabetes, Obesity and Lifestyle Study (AusDiab)	1999-2012, 11.7 years follow-up	6242 participants, age ≥ 25 years, 376 cases	Validated semi-quantitative FFQ, 80 items	Standard oral glucose tolerance test	Vegetables Fruit	<2.5 serv/d 2.5-4.9 5.0-5.9 ≥6 <0.75 serv/d 0.75-1.4 1.5-2.4 ≥2.5	1.00 0.89 (0.72, 1.11) 0.83 (0.37, 1.88) 0.29 (0.04, 2.10) 1.00 0.81 (0.62, 1.05) 0.68 (0.51, 0.91) 1.04 (0.76, 1.43)	Age, sex, education, smoking status, recreational physical activity, high triglycerides, low HDL cholesterol, family history of diabetes, energy intake, hypertension and waist circumference
Lee DH et al, 2019, USA	The Nurses' Health Study (NHS)	1986-2012, 22 years follow-up	67 139 women, age 30-55 years, 6946 cases	Validated FFQ, 116 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American	Mushrooms	Never/almost never <1 serv/wk 1 2-4 ≥5 Per 2 serv/wk increase	1.00 1.03 (0.96, 1.10) 1.10 (1.02, 1.18) 1.18 (1.08, 1.28) 1.04 (0.91, 1.19) 1.00 (0.98, 1.03)	Age, total calorie intake, smoking, physical activity, race, family history of type 2 diabetes, baseline high blood cholesterol, baseline high blood pressure, alcohol intake,

					Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review				multivitamin use, Prudent dietary pattern, Western dietary pattern, menopausal status and postmenopausal hormone use
Lee DH et al, 2019, USA	The Health Professionals Follow-up Study (HPFS)	1986-2012, 19.8 years follow-up	43 541 men, age 40-75 years, 3544 cases	Validated FFQ, 131 items	Self-reported/ supplemental questionnaire/ the National Diabetes Data group criteria (before 1997) or American Diabetes criteria (after 1998). Questionnaire -confirmed diagnosis of T2D was reconfirmed by medical record review	Mushrooms	Never/almost never <1 serv/wk 1 2-4 ≥5 Per 2 serv/wk increase	1.00 1.03 (0.94, 1.13) 1.02 (0.92, 1.13) 1.01 (0.89, 1.14) 1.04 (0.83, 1.31) 0.98 (0.94, 1.03)	Age, total calorie intake, smoking, physical activity, race, family history of type 2 diabetes, baseline high blood cholesterol, baseline high blood pressure, alcohol intake, multivitamin use, Prudent dietary pattern and Western dietary pattern
Scheffers FR et al, 2020, Netherlands	European Prospective Investigation into Cancer and Nutrition-Netherlands Study	1993-1997 - 2010, 14.6 years follow-up	36 147 men and women, age 20-69 years, 1477 cases	Validated FFQ, 178 items	Linkage to hospital discharge, diagnosis registry, and follow-up questionnaires , validated (up to 2006) by consulting the general practitioner or	Pure fruit juice (150 ml/glass)	Non-drinker <1 glass/wk 1-<4 4-<8 ≥8	1.00 1.00 (0.85-1.17) 0.98 (0.84-1.14) 0.97 (0.84-1.14) 0.98 (0.80-1.21)	Age, sex, education, physical activity, smoking, family history of diabetes, Dutch Healthy Diet Index 2015, alcohol, coffee, sugar-sweetened beverages, fruit, BMI, waist circumference

					pharmacist and general practitioner (after 2006)				
Rayner J et al, 2020, Australia	Australian Longitudinal Study on Women's Health	2001-2016, 15 years follow-up	9689 women, age 50-55 years, 959 cases	Validated FFQ, 80 items	Self-reported T2D were obtained at follow-up surveys and validated against hospital discharge data in a subset of the cohort	Fruit Fruit juice Vegetables	0.62 serv/d 1.18 1.77 2.74 0.01 serv/d 0.10 0.43 1.30 1.11 serv/d 1.75 2.26 3.28	1.22 (1.01-1.48) 1.06 (0.88-1.26) 1.10 (0.88-1.36) 1.00 0.94 (0.80-1.10) 0.90 (0.75-1.07) 0.95 (0.82-1.11) 1.00 1.03 (0.84-1.26) 1.02 (0.82-1.26) 1.01 (0.87-1.19) 1.00	Age, country of birth, energy intake, highest educational qualification, employment status, years of follow-up, history of gestational diabetes, physical activity, cereal, high fiber bread, pasta and rice, discretionary foods, white bread, dairy, red and processed meat, fish, BMI, added sugar
Ahmed A et al, 2020, Sweden	Stockholm Public Health Cohort	2010-2014, 4 years follow-up	14 718 men and 20 589 women, age 25-84 years, 319 cases	FFQ	Self-report	Vegetables (men) Fruit (men) Fruit and vegetables (men) Vegetables (women) Fruit (women) Fruit and vegetables (women)	≥2 serv/d <2 ≥2 serv/d <2 ≥4 serv/d <4 ≥2 serv/d <2 ≥2 serv/d <2 ≥4 serv/d <4	1.00 1.62 (1.00-2.61) 1.00 1.04 (0.60-1.59) 1.00 1.17 (0.66-2.08) 1.00 1.18 (0.82-1.71) 1.00 0.90 (0.65-1.26) 1.00 1.07 (0.73-1.58)	Age, education, BMI, smoking, alcohol, physical activity

Supplemental Table 5. Modified Newcastle-Ottawa Scale (NOS) assessment of the included cohort studies

Author, year	Selection			Comparability	Outcome assessment			Total
	Selection of non-exposed cohort	Exposure ascertainment	Demonstration of outcome not present at start	0.25 points for each adjustment	Outcome assessment	Long enough follow-up (≥5 years)	Adequacy of follow-up (≤10% lost)	
Ford, 2000	1	1	1	2	0.5	1	0	6.5
Meyer, 2000	1	1	1	2	1	1	0	7
Knekt, 2002	1	1	1	0.75	0.5	1	0	5.25
Hodge, 2004	1	0	1	2	1	0	1	6
Liu, 2004	1	1	1	2	1	1	0	7
Schulze, 2004	1	1	1	2	1	1	1	8
Montonen, 2005	1	1	1	1.75	0.5	1	0	6.25
Song, 2005	1	1	1	2	1	1	0	7
Wang, 2006	1	1	1	2	1	1	0	7
Montonen, 2007	1	1	1	2	0.5	1	0	6.5
Bazzano, 2008	1	1	1	2	1	1	0	7
Palmer, 2008	1	1	1	2	1	1	0	7
Villegas, 2008	1	1	1	2	0	0	1	6
de Koning, 2011	1	1	1	2	1	1	1	8
Cooper, 2012	1	1	1	2	0.5	1	1	7.5
Elwood, 2013	1	0	0	0.5	0	1	0	2.5
Eshak, 2013	1	1	1	2	1	1	0	7
Fagherazzi, 2013	1	1	1	2	1	1	1	8
Jacques, 2013	1	0	1	1.5	1	1	0	5.5
Kurotani, 2013	1	1	1	2	1	1	0	7
Muraki (NHS), 2013	1	1	1	2	1	1	1	8
Muraki (NHS II), 2013	1	1	1	2	1	1	1	8

Muraki, (HPFS) 2013	1	1	1	2	1	1	1	8
Romaguera, 2013	1	1	1	2	0.5	1	0	6.5
Mursu, 2014	1	1	1	2	1	1	1	8
Qiao, 2014	1	1	1	2	1	1	0	7
Lacoppidan, 2015	1	0	1	2	0.5	1	0	5.5
Muraki (NHS), 2016	1	1	1	2	1	1	0	7
Muraki (NHS II), 2016	1	1	1	2	1	1	0	7
Muraki (HPFS), 2016	1	1	1	2	1	1	0	7
Muraki (NHS, NHS II, HPFS), 2016	1	1	1	2	1	1	0	7
Alperet, 2017	1	1	1	2	1	1	0	7
Auerbach, 2017	1	1	1	2	1	1	0	7
Bahadoran, 2017	1	1	1	1	1	1	0	6
Du, 2017	1	0	1	2	1	1	1	7.0
Huang, 2017	1	1	1	2	1	1	0	7
Lv, 2017	1	0	1	2	1	1	1	7.0
Mamluk (NIH-AARP), 2017	1	1	1	2	0	1	0	6
Mamluk (EPIC-Elderly Greece, 2017	1	1	1	2	0	1	0	6
Chen, 2018	1	1	1	2	1	1	0	7
Farhadnejad, 2018	1	1	1	2	1	1	0	7
Khalili-Moghadam, 2018	1	1	1	1.25	1	1	0	6.25
Ma (NHS), 2018	1	1	1	2	1	1	0	7
Ma (NHS II), 2018	1	1	1	2	1	1	0	7
Ma (HPFS), 2018	1	1	1	2	1	1	0	7
Dow, 2019	1	1	1	2	1	1	0	7
Lee (NHS), 2019	1	1	1	2	1	1	1	8

Lee (HPFS), 2019	1	1	1	2	1	1	1	8
Scheffers, 2020	1	1	1	2	1	1	0	7
Rayner, 2020	1	1	1	2	0.5	1	0	6.5
Ahmed, 2020	1	0	1	1.5	0	0	0	3.5

Supplemental Table 6. Relative risks (95% confidence intervals) from nonlinear analysis of fruit and vegetable intake and type 2 diabetes

Fruit and vegetables (n=8)		Fruits (n=19)		Vegetables (n=15)	
g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)
0	1.00	0	1.00	24	1.00
100	0.97 (0.94-1.00)	100	0.92 (0.88-0.95)	100	0.94 (0.89-0.98)
200	0.95 (0.89-1.00)	200	0.87 (0.82-0.93)	200	0.88 (0.80-0.97)
300	0.92 (0.84-1.01)	300	0.88 (0.83-0.93)	300	0.86 (0.77-0.97)
400	0.91 (0.82-1.01)	400	0.90 (0.85-0.94)	400	0.87 (0.77-0.98)
500	0.90 (0.81-1.01)	500	0.92 (0.87-0.97)	500	0.88 (0.77-1.00)
600	0.90 (0.81-1.00)	600	0.94 (0.88-1.01)	600	0.89 (0.78-1.02)
700	0.91 (0.82-1.00)				
800	0.91 (0.82-1.01)				
$p_{nonlinearity}$	0.13	$p_{nonlinearity}$	<0.0001	$p_{nonlinearity}$	0.004

Supplemental Table 7. Relative risks (95% confidence intervals) from nonlinear analysis of fruit and vegetable subtypes and type 2 diabetes

Apples (n=2)		Apples and pears (n=4)		Bananas (n=5)		Berries (n=5)		Blueberries (n=3)	
g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)
0	1.00	0	1.00	0	1.00	0	1.00	1	1.00
50	0.91 (0.83-1.01)	50	0.90 (0.83-0.97)	20	0.95 (0.91-1.00)	10	0.93 (0.83-1.03)	10	0.86 (0.81-0.91)
100	0.86 (0.75-0.99)	100	0.87 (0.80-0.95)	40	0.92 (0.85-1.00)	20	0.89 (0.76-1.04)	20	0.79 (0.72-0.86)
150	0.83 (0.74-0.95)	150	0.87 (0.78-0.96)	60	0.91 (0.83-1.01)	30	0.89 (0.78-1.03)	30	0.76 (0.69-0.83)
200	0.82 (0.73-0.92)			80	0.91 (0.81-1.03)	40	0.92 (0.84-1.01)	40	0.76 (0.68-0.84)
250	0.81 (0.71-0.93)			100	0.92 (0.80-1.06)	50	0.97 (0.89-1.07)		
				120	0.92 (0.78-1.10)	60	1.05 (0.86-1.27)		
				140	0.93 (0.77-1.13)	70	1.13 (0.82-1.55)		
$p_{nonlinearity}$	0.37	$p_{nonlinearity}$	0.07	$p_{nonlinearity}$	0.04	$p_{nonlinearity}$	0.23	$p_{nonlinearity}$	0.003

Supplemental Table 8. Relative risks (95% confidence intervals) from nonlinear analysis of fruit and vegetable subtypes and type 2 diabetes

Cantaloupe (n=3)		Citrus fruits (n=6)		Oranges (n=4)		Grapefruit (n=3)		Grapes and raisins (n=4)	
g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)
2	1.00	0	1.00	0	1.00	2	1.00	0	1.00
10	1.05 (1.01-1.09)	50	1.01 (0.97-1.06)	20	0.99 (0.95-1.03)	20	0.97 (0.92-1.02)	10	0.88 (0.83-0.94)
20	1.09 (1.02-1.16)	100	1.02 (0.96-1.09)	40	0.98 (0.93-1.04)	40	0.95 (0.87-1.03)	20	0.83 (0.77-0.90)
30	1.12 (1.03-1.21)	150	1.03 (0.96-1.11)	60	0.99 (0.93-1.05)	60	0.94 (0.86-1.02)	30	0.83 (0.76-0.90)
40	1.14 (1.04-1.24)	200	1.04 (0.94-1.15)	80	0.99 (0.94-1.05)	80	0.93 (0.85-1.02)	40	0.84 (0.74-0.97)
50	1.14 (1.05-1.25)	250	1.05 (0.92-1.21)	100	1.00 (0.95-1.06)	100	0.93 (0.84-1.03)		
60	1.14 (1.05-1.25)	300	1.06 (0.89-1.28)	120	1.01 (0.96-1.08)				
70	1.14 (1.05-1.23)	330	1.07 (0.87-1.31)	130	1.02 (0.96-1.09)				
80	1.13 (1.05-1.22)								
$p_{nonlinearity}$	0.04	$p_{nonlinearity}$	0.94	$p_{nonlinearity}$	0.41	$p_{nonlinearity}$	0.49	$p_{nonlinearity}$	0.01

Supplemental Table 9. Relative risks (95% confidence intervals) from nonlinear analysis of fruit and vegetable subtypes and type 2 diabetes

Peaches, plums, apricots (n=3)		Prunes (n=3)		Strawberries (n=3)		Watermelon (n=2)		Allium vegetables (n=3)	
g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)
1	1.00	0	1.00	1	1.00	g/d	RR (95% CI)	0	1.00
10	1.01 (0.97-1.05)	10	0.90 (0.82-0.98)	10	1.00 (0.94-1.06)	0	1.00	5	0.81 (0.67-0.97)
20	1.01 (0.94-1.08)	20	0.85 (0.74-0.97)	20	1.01 (0.91-1.12)	50	0.94 (0.74-1.21)	10	0.72 (0.55-0.96)
30	1.00 (0.92-1.09)	30	0.84 (0.74-0.96)	30	1.03 (0.90-1.19)	100	0.92 (0.62-1.35)	15	0.71 (0.52-0.96)
40	0.98 (0.89-1.08)	40	0.86 (0.77-0.97)	40	1.06 (0.90-1.26)	150	0.92 (0.63-1.35)	20	0.72 (0.53-0.97)
50	0.96 (0.86-1.07)	50	0.91 (0.79-1.05)	50	1.10 (0.90-1.36)	200	0.96 (0.72-1.27)	23	0.72 (0.53-0.99)
60	0.93 (0.83-1.06)			60	1.15 (0.89-1.49)	220	0.97 (0.77-1.24)		
70	0.91 (0.78-1.05)								
74	0.89 (0.76-1.05)								
$p_{nonlinearity}$	0.29	$p_{nonlinearity}$	0.06	$p_{nonlinearity}$	0.39	$p_{nonlinearity}$	0.61	$p_{nonlinearity}$	0.045

Supplemental Table 10. Relative risks (95% confidence intervals) from nonlinear analysis of fruit and vegetable subtypes and type 2 diabetes

Broccoli (n=4)		Brussels sprouts (n=3)		Cabbage (n=6)		Cauliflower (n=3)		Cruciferous vegetables (n=8)	
g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)
0	1.00	1	1.00	0.8	1.00	1	1.00	0	1.00
20	1.01 (0.93-1.09)	2	1.02 (1.00-1.05)	20	1.15 (1.03-1.28)	2	0.98 (0.95-1.01)	20	0.97 (0.90-1.05)
40	1.03 (0.98-1.09)	4	1.05 (1.01-1.09)	40	1.20 (1.01-1.42)	4	0.96 (0.90-1.02)	40	0.96 (0.84-1.09)
60	1.07 (0.93-1.23)	6	1.07 (1.01-1.14)	60	1.23 (0.97-1.56)	6	0.96 (0.89-1.03)	60	0.96 (0.82-1.12)
80	1.11 (0.85-1.44)	8	1.10 (1.03-1.17)	80	1.26 (0.92-1.73)	8	0.98 (0.91-1.05)	80	0.97 (0.82-1.13)
100	1.14 (0.78-1.65)	10	1.12 (1.04-1.21)	100	1.29 (0.87-1.92)	10	1.01 (0.95-1.08)	100	0.99 (0.85-1.15)
		12	1.15 (1.06-1.25)	110	1.30 (0.84-2.02)	11	1.03 (0.97-1.09)	120	1.01 (0.87-1.17)
		14	1.18 (1.07-1.29)					140	1.04 (0.89-1.20)
$p_{nonlinearity}$	0.81	$p_{nonlinearity}$	0.98	$p_{nonlinearity}$	0.04	$p_{nonlinearity}$	0.03	$p_{nonlinearity}$	0.32

Supplemental Table 11. Relative risks (95% confidence intervals) from nonlinear analysis of fruit and vegetable subtypes and type 2 diabetes

Green leafy vegetables (n=8)		Kale, mustard and chard greens (n=3)		Mushrooms (n=2)		Tomatoes (n=3)		Yellow vegetables (n=4)	
g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)
1.6	1.00	1	1.00	0.45	1.00	0	1.00	0	1.00
20	0.92 (0.82-1.04)	2	1.02 (0.99-1.05)	5	1.07 (0.97-1.17)	20	0.91 (0.68-1.23)	20	0.84 (0.66-1.07)
40	0.87 (0.70-1.07)	4	1.04 (0.99-1.10)	10	1.10 (0.96-1.27)	40	0.88 (0.57-1.37)	40	0.77 (0.55-1.08)
60	0.85 (0.66-1.09)	6	1.06 (0.98-1.13)	15	1.11 (0.95-1.28)	60	0.89 (0.56-1.40)	60	0.75 (0.53-1.05)
80	0.84 (0.65-1.10)	8	1.07 (0.99-1.16)	20	1.09 (0.95-1.25)	80	0.92 (0.61-1.38)	80	0.75 (0.56-1.01)
100	0.85 (0.66-1.10)	10	1.08 (0.99-1.18)	25	1.06 (0.93-1.21)	100	0.96 (0.68-1.34)	100	0.77 (0.59-1.00)
120	0.85 (0.66-1.11)	12	1.09 (0.99-1.20)						
140	0.86 (0.66-1.12)	13	1.10 (0.99-1.21)						
$p_{nonlinearity}$	0.21	$p_{nonlinearity}$	0.63	$p_{nonlinearity}$	0.22	$p_{nonlinearity}$	0.50	$p_{nonlinearity}$	0.27

Supplemental Table 12. Relative risks (95% confidence intervals) from nonlinear analysis of potatoes and type 2 diabetes

Potatoes, boiled (n=2)		Potatoes, total (n=8)	
g/d	RR (95% CI)	g/d	RR (95% CI)
2.4	1.00	0	1.00
20	0.85 (0.58-1.25)	50	0.98 (0.89-1.08)
40	0.74 (0.35-1.58)	100	0.99 (0.84-1.16)
60	0.66 (0.21-2.08)	150	1.02 (0.85-1.23)
80	0.60 (0.12-2.91)	200	1.08 (0.89-1.31)
100	0.55 (0.07-4.39)	250	1.15 (0.95-1.40)
120	0.52 (0.04-7.06)	300	1.22 (1.00-1.50)
140	0.49 (0.02-12.02)	325	1.26 (1.02-1.55)
160	0.47 (0.01-21.39)		
$p_{nonlinearity}$	0.71	$p_{nonlinearity}$	0.15

Supplemental Table 13. Relative risks (95% confidence intervals) from nonlinear analysis of fruit juice and fruit drinks and type 2 diabetes

Fruit juice (n=9)		100% fruit juice (n=4)		Fruit drinks (n=6)	
g/d	RR (95% CI)	g/d	RR (95% CI)	g/d	RR (95% CI)
0	1.00	0	1.00	0	1.00
200	1.02 (0.97-1.07)	200	0.99 (0.89-1.11)	100	1.07 (0.99-1.14)
400	1.03 (0.97-1.10)	400	1.06 (0.63-1.80)	200	1.14 (1.01-1.28)
600	1.05 (0.99-1.11)	600	1.14 (0.42-3.12)	300	1.21 (0.99-1.47)
800	1.06 (1.01-1.12)	800	1.22 (0.28-5.35)	400	1.28 (0.95-1.72)
1000	1.08 (1.02-1.13)			500	1.36 (0.90-2.04)
1200	1.09 (1.04-1.15)				
1400	1.11 (1.05-1.16)				
1600	1.12 (1.07-1.18)				
1800	1.14 (1.08-1.20)				
$p_{nonlinearity}$	0.87	$p_{nonlinearity}$	0.74	$p_{nonlinearity}$	0.93

Supplemental Table 14. Subgroup analyses of fruit and vegetable intake and type 2 diabetes, high vs. low and dose-response

		Fruit and vegetables, high vs. low						Fruit and vegetables, dose-response (200 g/day)				
		n	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]		*n*	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]
All studies		10	0.93 (0.89-0.98)	0	0.47			7	0.98 (0.95-1.01)	37.8	0.14	
Duration of follow-up												
<10 years follow-up		5	0.93 (0.88-0.99)	0	0.54	0.54		3	1.01 (0.97-1.05)	0	0.75	0.14
≥10 years follow-up		5	0.91 (0.83-1.01)	27.9	0.24			4	0.95 (0.91-1.00)	46.3	0.13	
Gender												
Men		5	0.88 (0.74-1.04)	0	0.73	0.92/		1	0.89 (0.76-1.03)			0.46
Women		5	0.95 (0.81-1.11)	43.8	0.13	0.30		3	1.00 (0.97-1.04)	0	0.62	
Men and women		3	0.92 (0.87-0.97)	0	0.37			3	0.95 (0.90-1.01)	45.8	0.16	
Geographic location												
Europe		4	0.88 (0.80-0.98)	0	0.76	0.68		2	0.95 (0.91-1.00)	3.2	0.31	0.32
America		4	1.00 (0.92-1.09)	0	0.41			4	0.99 (0.94-1.04)	54.2	0.09	
Asia		2	0.91 (0.86-0.97)	0	0.62			1	1.00 (0.92-1.09)			
Australia												
Number of cases												
Cases <1.000		3	0.84 (0.70-1.02)	0	0.65	0.42		2	0.96 (0.85-1.08)	49.0	0.16	0.95
Cases 1.000-<2.000		3	0.95 (0.81-1.11)	14.1	0.31			3	0.98 (0.90-1.06)	69.5	0.04	
Cases ≥2.000		4	0.94 (0.89-1.01)	30.1	0.23			2	0.98 (0.95-1.01)	0	0.36	
Study quality												
0-3		1	0.91 (0.62-1.33)			0.84		0				NC
>3-6		1	0.91 (0.66-1.25)					0				
>6-8		8	0.94 (0.89-0.99)	19.1	0.28			7	0.98 (0.95-1.01)	55.4	0.03	
Adjustment for confounders												
Age	Yes	10	0.93 (0.89-0.98)	0	0.47	NC	Yes	7	0.98 (0.95-1.01)	55.4	0.03	NC
	No	0					No	0				
Education	Yes	6	0.91 (0.86-0.95)	0	0.56	0.07	Yes	4	0.95 (0.89-1.02)	59.3	0.06	0.28
	No	4	1.01 (0.92-1.10)	0	0.93		No	3	1.00 (0.96-1.03)	0	0.95	
Ethnicity	Yes	0				NC	Yes	0				NC
	No	10	0.93 (0.89-0.98)	0	0.47		No	7	0.98 (0.95-1.01)	55.4	0.03	
Family history	Yes	4	0.93 (0.86-1.02)	34.3	0.21	0.93	Yes	4	0.99 (0.96-1.02)	0	0.50	0.46
	No	6	0.94 (0.86-1.02)	0	0.54		No	3	0.96 (0.89-1.04)	67.6	0.05	
Body mass index	Yes	9	0.94 (0.89-0.98)	7.7	0.37	0.89	Yes	7	0.98 (0.95-1.01)	55.4	0.03	NC
	No	1	0.91 (0.62-1.33)				No	0				
Waist circumference/WHR	Yes	3	0.91 (0.81-1.03)	34.6	0.22	0.40	Yes	2	0.97 (0.83-1.13)	70	0.07	0.69
	No	7	0.96 (0.89-1.02)	0	0.59		No	5	0.98 (0.94-1.01)	32.5	0.21	
Hypertension	Yes	3	0.96 (0.83-1.11)	18.4	0.29	0.64	Yes	2	1.00 (0.96-1.05)	0	0.98	0.45
	No	7	0.93 (0.88-0.97)	0	0.43		No	5	0.97 (0.92-1.01)	52.8	0.08	
Alcohol	Yes	9	0.94 (0.89-0.98)	7.7	0.37	0.89	Yes	7	0.98 (0.95-1.01)	55.4	0.03	NC
	No	1	0.91 (0.62-1.33)				No	0				

Smoking	Yes	9	0.94 (0.89-0.98)	7.7	0.37	0.89	Yes	7	0.98 (0.95-1.01)	55.4	0.03	NC
	No	1	0.91 (0.62-1.33)				No	0				
Physical activity	Yes	9	0.94 (0.89-0.98)	7.7	0.37	0.89	Yes	7	0.98 (0.95-1.01)	55.4	0.03	NC
	No	1	0.91 (0.62-1.33)				No	0				
Meat	Yes	2	0.95 (0.86-1.05)	60.9	0.11	0.76	Yes	1	0.99 (0.95-1.04)			0.74
	No	8	0.93 (0.86-1.00)	0	0.53		No	6	0.97 (0.93-1.02)	46.5	0.10	
Soft drinks	Yes	1	1.01 (0.90-1.12)			0.16	Yes	1	0.99 (0.95-1.04)			0.74
	No	9	0.92 (0.87-0.96)	0	0.62		No	6	0.97 (0.93-1.02)	46.5	0.10	
Whole grains	Yes	2	0.96 (0.86-1.05)	60.9	0.11	0.76	Yes	1	0.99 (0.95-1.04)			0.74
	No	8	0.93 (0.86-1.00)	0	0.53		No	6	0.97 (0.93-1.02)	46.5	0.10	
Coffee	Yes	2	1.00 (0.91-1.11)	0	0.79	0.15	Yes	2	0.99 (0.95-1.04)	0	0.81	0.56
	No	8	0.92 (0.87-0.96)	0	0.54		No	5	0.97 (0.92-1.02)	55.1	0.06	
Energy intake	Yes	6	0.96 (0.90-1.04)	14.4	0.32	0.21	Yes	6	0.99 (0.96-1.01)	3.2	0.40	0.09
	No	4	0.90 (0.85-0.96)	0	0.84		No	1	0.88 (0.80-0.98)			

n = number of studies
[a] *P* for heterogeneity within each subgroup
[b] *P* for heterogeneity between subgroups with meta-regression analysis
NC not calculatable

Supplemental Table 15. Subgroup analyses of fruit intake and type 2 diabetes, high vs. low and dose-response

		Fruits, high vs. low						Fruits, dose-response (200 g/day)				
		n	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]		*n*	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]
All studies		20	0.93 (0.90-0.97)	9.3	0.34			19	0.96 (0.92-1.00)	68.7	<0.0001	
Duration of follow-up												
<10 years follow-up		9	0.96 (0.89-1.04)	33.4	0.15	0.64		8	0.98 (0.87-1.09)	84.7	<0.0001	0.50
≥10 years follow-up		11	0.94 (0.91-0.97)	0	0.58			11	0.97 (0.95-0.99)	4.3	0.40	
Gender												
Men		5	1.01 (0.86-1.18)	44.7	0.12	0.10/		4	0.99 (0.90-1.10)	41.5	0.16	0.47/
Women		9	0.96 (0.91-1.02)	0	0.48	0.73		9	0.98 (0.92-1.04)	61.3	0.008	0.80
Men and women		9	0.91 (0.88-0.95)	12.0	0.34			8	0.91 (0.82-1.01)	82.6	<0.0001	
Geographic location												
Europe		5	0.94 (0.84-1.04)	0	0.60	0.52		4	0.95 (0.89-1.03)	0	0.62	0.41
America		7	0.94 (0.91-0.98)	0	0.55			7	0.98 (0.95-1.02)	21.7	0.26	
Asia		5	0.97 (0.86-1.08)	58.2	0.05			5	0.94 (0.82-1.08)	89.7	<0.0001	
Australia		3	0.87 (0.75-1.01)	0	0.44			3	0.90 (0.81-1.01)	0	0.51	
Number of cases												
Cases <1.000		6	0.94 (0.83-1.07)	0	0.68	0.69		5	0.93 (0.84-1.03)	0	0.73	0.96
Cases 1.000-<2.000		4	0.98 (0.84-1.16)	0	0.69			4	1.00 (0.89-1.12)	47.6	0.13	
Cases ≥2.000		10	0.93 (0.90-0.97)	19.4	0.26			10	0.95 (0.90-1.00)	81.4	<0.0001	
Study quality												
0-3		0				0.18		0				0.18
>3-6		5	0.96 (0.92-1.00)	0	0.57			5	1.00 (0.95-1.06)	43.3	0.15	
>6-8		15	0.91 (0.88-0.95)	3.9	0.41			14	0.94 (0.88-0.99)	65.1	<0.0001	
Adjustment for confounders												
Age	Yes	19	0.94 (0.91-0.97)	10.8	0.32	0.39	Yes	18	0.96 (0.92-1.00)	69.9	<0.0001	0.40
	No	1	0.75 (0.46-1.22)				No	1	0.79 (0.53-1.19)			
Education	Yes	13	0.95 (0.90-1.00)	34.2	0.11	0.38	Yes	12	0.96 (0.91-1.02)	78.2	<0.0001	0.54
	No	7	0.91 (0.86-0.97)	0	0.91		No	7	0.94 (0.89-1.00)	0	0.52	
Ethnicity	Yes	5	0.90 (0.84-0.97)	0	0.33	0.29	Yes	5	0.95 (0.90-1.01)	18.0	0.30	0.69
	No	15	0.95 (0.91-1.00)	29.3	0.14		No	14	0.96 (0.91-1.02)	74.9	<0.0001	
Family history	Yes	11	0.90 (0.86-0.94)	0	0.94	0.03	Yes	11	0.91 (0.85-0.98)	56.0	0.01	0.04
	No	9	0.98 (0.92-1.04)	26.7	0.21		No	8	1.00 (0.96-1.04)	41.6	0.10	
Body mass index	Yes	18	0.93 (0.90-0.97)	13.8	0.29	0.96	Yes	18	0.96 (0.92-1.00)	71.6	<0.0001	0.57
	No	2	0.93 (0.69-1.26)	17.7	0.27		No	2	0.89 (0.71-1.12)	0	0.49	
Waist circumference/WHR	Yes	5	1.04 (0.94-1.16)	0	0.70	0.04	Yes	6	1.03 (0.96-1.10)	12.7	0.33	0.16
	No	15	0.92 (0.90-0.95)	0	0.51		No	13	0.94 (0.89-0.98)	74.9	<0.0001	
Hypertension	Yes	4	1.01 (0.91-1.11)	0	0.91	0.14	Yes	5	1.03 (0.98-1.09)	0	0.50	0.18
	No	16	0.93 (0.89-0.96)	15.3	0.28		No	14	0.94 (0.89-0.99)	74.1	<0.0001	
Alcohol	Yes	12	0.96 (0.91-1.01)	31.5	0.14	0.13	Yes	11	0.97 (0.92-1.03)	78.6	<0.0001	0.24
	No	8	0.89 (0.84-0.95)	0	0.91		No	8	0.93 (0.87-0.99)	19.4	0.28	

Smoking	Yes	17	0.94 (0.91-0.97)	11.3	0.32	0.12	Yes	16	0.96 (0.92-1.01)	71.7	<0.0001	0.23
	No	3	0.82 (0.70-0.96)	0	0.92		No	3	0.88 (0.79-0.99)	0	0.46	
Physical activity	Yes	18	0.94 (0.91-0.97)	12.6	0.30	0.25	Yes	17	0.96 (0.92-1.00)	71.0	<0.0001	0.23
	No	2	0.80 (0.62-1.03)	0	0.76		No	2	0.80 (0.62-1.04)	0	0.94	
Meat	Yes	3	0.91 (0.81-1.03)	61.4	0.08	0.06	Yes	3	0.88 (0.70-1.12)	94.3	<0.0001	0.21
	No	17	0.95 (0.92-0.98)	0	0.76		No	16	0.98 (0.97-1.00)	0	0.66	
Soft drinks	Yes	1	1.08 (0.91-1.28)			0.12	Yes	1	0.98 (0.90-1.06)			0.79
	No	19	0.93 (0.90-0.95)	0	0.46		No	18	0.95 (0.91-1.00)	70.4	<0.0001	
Whole grains	Yes	1	0.82 (0.68-0.99)			0.20	Yes	1	0.81 (0.65-1.00)			0.21
	No	19	0.94 (0.91-0.97)	5.8	0.39		No	18	0.96 (0.92-1.00)	68.7	<0.0001	
Coffee	Yes	2	1.04 (0.91-1.19)	0	0.49	0.14	Yes	2	0.99 (0.93-1.06)	0	0.57	0.51
	No	18	0.93 (0.90-0.96)	3.9	0.41		No	17	0.95 (0.90-1.00)	72.0	<0.0001	
Energy intake	Yes	17	0.95 (0.92-0.98)	0	0.58	0.05	Yes	17	0.98 (0.96-1.01)	17.1	0.25	<0.0001
	No	3	0.89 (0.82-0.97)	7.0	0.34		No	2	0.79 (0.73-0.84)	0	0.97	

n = number of studies
[a] *P* for heterogeneity within each subgroup
[b] *P* for heterogeneity between subgroups with meta-regression analysis
NC not calculatable

Supplemental Table 16. Subgroup analyses of vegetable intake and type 2 diabetes, high vs. low and dose-response

		Vegetables, high vs. low						Vegetables, dose-response (200 g/day)				
		n	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]		*n*	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]
All studies		17	0.95 (0.88-1.02)	60.4	0.001			15	0.97 (0.94-1.01)	39.2	0.06	
Duration of follow-up												
<10 years follow-up		8	0.92 (0.80-1.05)	65.3	0.005	0.59		6	0.94 (0.85-1.04)	62.3	0.02	0.48
≥10 years follow-up		9	0.97 (0.89-1.05)	59.8	0.01			9	1.00 (0.98-1.02)	0	0.51	
Gender												
Men		3	0.78 (0.64-0.94)	0	0.61	0.35/		2	0.85 (0.71-1.01)	0	0.76	0.52/
Women		8	0.97 (0.87-1.09)	63.2	0.008	0.11		6	0.98 (0.90-1.05)	66.1	0.01	0.26
Men and women		8	0.95 (0.87-1.05)	55.8	0.03			8	1.00 (0.97-1.02)	0	0.63	
Geographic location												
Europe		5	0.87 (0.73-1.03)	48.3	0.10	0.55		4	0.95 (0.88-1.02)	0	0.12	0.32
America		5	1.02 (0.93-1.11)	61.3	0.04			4	1.01 (0.99-1.03)	0	0.76	
Asia		4	0.89 (0.70-1.13)	83.6	<0.0001			4	0.91 (0.81-1.02)	48.9	0.12	
Australia		3	0.94 (0.79-1.12)	0	0.46			3	0.91 (0.78-1.05)	0	0.59	
Number of cases												
Cases <1.000		7	0.87 (0.74-1.03)	48.8	0.07	0.27		7	0.88 (0.80-0.98)	0	0.93	0.05
Cases 1.000-<2.000		4	1.00 (0.85-1.19)	35.7	0.20			4	0.96 (0.87-1.06)	74.7	0.008	
Cases ≥2.000		6	0.96 (0.87-1.05)	78.8	<0.0001			4	1.00 (0.98-1.03)	0	0.63	
Study quality												
0-3		0				0.05		0				0.46
>3-6		5	0.85 (0.71-1.02)	69.5	0.01			4	0.93 (0.83-1.05)	77.8	0.004	
>6-8		12	1.00 (0.95-1.06)	25.2	0.20			11	1.00 (0.96-1.03)	0	0.49	
Adjustment for confounders												
Age	Yes	16	0.95 (0.88-1.02)	62.8	<0.0001	0.82	Yes	14	0.97 (0.94-1.01)	43.2	0.04	0.77
	No	1	0.89 (0.57-1.39)				No	1	0.89 (0.53-1.51)			
Education	Yes	12	0.94 (0.86-1.03)	67.6	<0.0001	0.89	Yes	10	0.96 (0.91-1.01)	50.8	0.03	0.51
	No	5	0.98 (0.88-1.08)	23.6	0.26		No	5	1.01 (0.96-1.06)	3.8	0.39	
Ethnicity	Yes	1	0.88 (0.60-1.29)			0.76	Yes	1	0.59 (0.19-1.68)			0.38
	No	16	0.95 (0.88-1.02)	62.7	<0.0001		No	14	0.97 (0.94-1.01)	41.3	0.05	
Family history	Yes	9	0.98 (0.89-1.07)	28.6	0.19	0.80	Yes	8	0.98 (0.92-1.04)	20.5	0.27	0.85
	No	8	0.94 (0.85-1.04)	73.6	<0.0001		No	7	0.97 (0.92-1.03)	57.8	0.03	
Body mass index	Yes	15	0.95 (0.89-1.02)	64.0	<0.0001	0.63	Yes	13	0.98 (0.94-1.02)	43.8	0.05	0.35
	No	2	0.78 (0.39-1.58)	14.7	0.28		No	2	0.88 (0.72-1.06)	0	0.94	
Waist circumference/WHR	Yes	6	0.90 (0.74-1.10)	73.7	0.002	0.57	Yes	5	0.90 (0.78-1.02)	61.0	0.04	0.04
	No	11	0.97 (0.90-1.04)	52.3	0.02		No	10	1.00 (0.98-1.02)	0	0.80	
Hypertension	Yes	5	0.91 (0.74-1.11)	80.0	0.001	0.74	Yes	5	0.93 (0.85-1.02)	65.0	0.02	0.20
	No	12	0.96 (0.89-1.03)	45.0	0.05		No	10	1.00 (0.98-1.02)	0	0.62	
Alcohol	Yes	12	0.94 (0.87-1.02)	66.4	0.001	0.85	Yes	11	0.98 (0.94-1.02)	49.6	0.03	0.29
	No	5	0.96 (0.81-1.13)	40.5	0.15		No	4	0.90 (0.78-1.03)	0	0.80	

Smoking	Yes	14	0.95 (0.88-1.02)	67.6	<0.0001	0.89	Yes	12	0.97 (0.93-1.01)	49.8	0.03	0.75
	No	3	0.94 (0.80-1.11)	0	0.88		No	3	0.94 (0.77-1.15)	0	0.66	
Physical activity	Yes	15	0.96 (0.89-1.03)	63.3	<0.0001	0.32	Yes	13	0.97 (0.94-1.01)	44.1	0.04	0.33
	No	2	0.80 (0.63-1.03)	0	0.60		No	2	0.81 (0.58-1.13)	0	0.66	
Meat	Yes	4	0.95 (0.81-1.12)	83.9	<0.0001	0.80	Yes	4	0.96 (0.85-1.08)	77.5	0.004	0.87
	No	13	0.94 (0.88-1.01)	35.9	0.10		No	11	1.00 (0.97-1.02)	0	0.51	
Soft drinks	Yes	2	1.07 (1.00-1.14)	0	0.69	0.11	Yes	2	1.03 (0.97-1.09)	0	0.87	0.19
	No	15	0.92 (0.85-0.99)	50.3	0.01		No	13	0.96 (0.91-1.00)	43.2	0.05	
Whole grains	Yes	3	1.06 (0.99-1.13)	0	0.64	0.12	Yes	3	1.03 (0.97-1.09)	0	0.85	0.22
	No	14	0.91 (0.84-0.99)	53.5	0.009		No	12	0.95 (0.91-1.00)	47.8	0.03	
Coffee	Yes	3	1.05 (0.97-1.13)	13.4	0.32	0.22	Yes	3	1.01 (0.95-1.08)	13.5	0.32	0.40
	No	14	0.92 (0.85-1.00)	53.6	0.009		No	12	0.96 (0.91-1.01)	44.8	0.05	
Energy intake	Yes	15	0.96 (0.89-1.03)	62.8	0.001	0.26	Yes	14	0.97 (0.94-1.01)	43.2	0.04	0.77
	No	2	0.79 (0.62-1.01)	0	0.53		No	1	0.89 (0.53-1.51)	0	0	

n = number of studies
[a] *P* for heterogeneity within each subgroup
[b] *P* for heterogeneity between subgroups with meta-regression analysis
NC not calculatable

Supplemental Table 17. Subgroup analyses of cruciferous vegetable intake and type 2 diabetes, dose-response

		Cruciferous vegetables, 100 g/day				
		n	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]
All studies		8	0.96 (0.84-1.09)	80.9	<0.0001	
Duration of follow-up						
<10 years follow-up		3	0.75 (0.51-1.11)	82.8	0.003	0.20
≥10 years follow-up		5	1.07 (0.97-1.18)	67.5	0.02	
Gender						
Men		2	0.85 (0.42-1.73)	79.6	0.03	0.99
Women		4	0.94 (0.76-1.16)	87.4	0	
Men and women		2	0.91 (0.81-1.03)	0	0.79	
Geographic location						
Europe		1	0.55 (0.29-1.04)			0.53
America		4	1.13 (1.07-1.19)	0	0.53	
Asia		3	0.75 (0.54-1.05)	83.4	0.002	
Australia						
Number of cases						
Cases <1.000		2	0.77 (0.50-1.19)	47.1	0.17	0.14
Cases 1.000-<2.000		2	0.68 (0.33-1.39)	90.8	0.001	
Cases ≥2.000		4	1.09 (1.00-1.19)	61.1	0.05	
Study quality						
0-3		0				0.02
>3-6		1	0.47 (0.33-0.67)			
>6-8		7	1.04 (0.95-1.14)	62.4	0.01	
Adjustment for confounders						
Age	Yes	8	0.96 (0.84-1.09)	80.9	<0.0001	NC
	No	0				
Education	Yes	3	0.64 (0.38-1.08)	85.2	0.001	0.05
	No	5	1.10 (1.03-1.18)	29.5	0.23	
Ethnicity	Yes	3	1.13 (1.07-1.20)	0	0.75	0.03
	No	5	0.78 (0.62-0.99)	73.1	0.005	
Family history	Yes	6	1.08 (0.99-1.17)	51.3	0.07	0.15
	No	2	0.67 (0.34-1.30)	91.6	0.001	
Body mass index	Yes	8	0.96 (0.84-1.09)	80.9	<0.0001	NC
	No	0				
Waist circumference/WHR	Yes	2	0.48 (0.35-0.66)	0	0.68	0.005
	No	6	1.06 (0.98-1.15)	57.1	0.04	
Hypertension	Yes	7	0.98 (0.86-1.11)	81.6	<0.0001	0.38
	No	1	0.55 (0.29-1.04)			
Alcohol	Yes	8	0.96 (0.84-1.09)	80.9	<0.0001	NC
	No	0				
Smoking	Yes	8	0.96 (0.84-1.09)	80.9	<0.0001	NC
	No	0				
Physical activity	Yes	8	0.96 (0.84-1.09)	80.9	<0.0001	NC
	No	0				
Meat consumption	Yes	2	0.67 (0.34-1.30)	91.6	0.001	0.15
	No	6	1.08 (0.99-1.17)	51.3	0.07	
Soft drink	Yes	1	0.92 (0.80-1.06)			0.96
	No	7	0.96 (0.83-1.11)	81.2	<0.0001	
Whole grain	Yes	1	0.92 (0.80-1.06)			0.96
	No	7	0.96 (0.83-1.11)	81.2	<0.0001	
Coffee	Yes	2	0.91 (0.81-1.03)	0	0.79	0.99
	No	6	0.97 (0.84-1.14)	82.8	<0.0001	
Energy intake	Yes	8	0.96 (0.84-1.09)	80.9	<0.0001	NC
	No	0				

n = number of studies
[a] *P* for heterogeneity within each subgroup
[b] *P* for heterogeneity between subgroups with meta-regression analysis
NC not calculatable

Supplemental Table 18. Subgroup analyses of green leafy vegetable intake and type 2 diabetes, dose-response

		Green leafy vegetables, 100 g/day				
		n	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]
All studies		8	0.96 (0.91-1.01)	75.0	<0.0001	
Duration of follow-up						
<10 years follow-up		3	0.86 (0.76-0.96)	19.0	0.29	0.18
≥10 years follow-up		5	0.98 (0.93-1.03)	78.7	0.001	
Gender						
Men		0				
Women		3	0.87 (0.81-0.94)	0	0.41	0.06
Men and women		5	1.00 (0.94-1.05)	76.2	0.002	
Geographic location						
Europe		2	0.87 (0.57-1.32)	73.6	0.05	0.66
America		3	0.95 (0.88-1.01)	48.5	0.14	
Asia		3	0.90 (0.70-1.15)	78.2	0.01	
Australia		0				
Number of cases						
Cases <1.000		1	0.70 (0.44-1.12)			0.57
Cases 1.000-<2.000		3	0.93 (0.80-1.08)	83.2	0.003	
Cases ≥2.000		4	0.95 (0.86-1.05)	66.3	0.03	
Study quality						
0-3		0				0.74
>3-6		3	0.97 (0.92-1.03)	88.2	<0.0001	
>6-8		5	0.91 (0.80-1.05)	55.9	0.06	
Adjustment for confounders						
Age	Yes	8	0.96 (0.91-1.01)	75.0	<0.0001	NC
	No	0				
Education	Yes	5	0.98 (0.92-1.03)	81.9	<0.0001	0.44
	No	3	0.89 (0.82-0.97)	0	0.47	
Ethnicity	Yes	8	0.96 (0.91-1.01)	75.0	<0.0001	NC
	No	0				
Family history	Yes	3	0.89 (0.82-0.97)	0	0.47	0.44
	No	5	0.98 (0.92-1.03)	81.9	<0.0001	
Body mass index	Yes	8	0.96 (0.91-1.01)	75.0	<0.0001	NC
	No	0				
Waist circumference/WHR	Yes	1	0.82 (0.72-0.93)			0.18
	No	7	0.98 (0.93-1.02)	71.2	0.002	
Hypertension	Yes	4	0.92 (0.78-1.08)	67.8	0.03	0.81
	No	4	0.97 (0.92-1.02)	81.9	0.001	
Alcohol	Yes	8	0.96 (0.91-1.01)	75.0	<0.0001	NC
	No	0				
Smoking	Yes	8	0.96 (0.91-1.01)	75.0	<0.0001	NC
	No	0				
Physical activity	Yes	8	0.96 (0.91-1.01)	75.0	<0.0001	NC
	No	0				
Meat consumption	Yes	3	0.92 (0.79-1.07)	76.0	0.02	0.68
	No	5	0.98 (0.94-1.03)	73.1	0.005	
Soft drink	Yes	2	0.98 (0.78-1.22)	81.1	0.02	0.63
	No	6	0.96 (0.91-1.01)	77.4	0.001	
Whole grain	Yes	2	0.98 (0.78-1.22)	81.1	0.02	0.63
	No	6	0.96 (0.91-1.01)	77.4	0.001	
Coffee	Yes	3	0.86 (0.76-1.14)	70.4	0.03	0.93
	No	5	0.96 (0.91-1.02)	80.2	<0.0001	
Energy intake	Yes	8	0.96 (0.91-1.01)	75.0	<0.0001	NC
	No	0				

n = number of studies
[a] *P* for heterogeneity within each subgroup
[b] *P* for heterogeneity between subgroups with meta-regression analysis
NC not calculatable

Supplemental Table 19. Subgroup analyses of potato (total) intake and type 2 diabetes, dose-response

		Potatoes (total), 100 g/day				
		n	RR (95% CI)	I^2 (%)	P_h[a]	P_h[b]
All studies		8	1.08 (1.02-1.15)	55.4	0.03	
Duration of follow-up						
<10 years follow-up		3	0.95 (0.78-1.16)	60.1	0.08	0.08
≥10 years follow-up		5	1.11 (1.08-1.15)	0	0.43	
Gender						
Men		1	1.12 (1.04-1.20)			0.64
Women		3	1.09 (1.02-1.15)	57.5	0.01	
Men and women		4	0.94 (0.71-1.24)	71.3	0.02	
Geographic location						
Europe		1	1.17 (1.02-1.35)			0.20
America		4	1.10 (1.05-1.14)	39.5	0.18	
Asia		2	0.46 (0.19-1.13)	43.1	0.19	
Australia		1	0.97 (0.81-1.15)			
Number of cases						
Cases <1.000		3	0.99 (0.74-1.33)	76.6	0.01	0.45
Cases 1.000-<2.000		1	1.00 (0.91-1.10)			
Cases ≥2.000		4	1.11 (1.07-1.15)	6.7	0.36	
Study quality						
0-3		0				0.38
>3-6		1	0.97 (0.81-1.15)			
>6-8		7	1.09 (1.03-1.16)	56.1	0.03	
Adjustment for confounders						
Age	Yes	8	1.08 (1.02-1.15)	55.4	0.03	NC
	No	0				
Education	Yes	2	0.92 (0.72-1.18)	12.0	0.29	0.28
	No	6	1.10 (1.04-1.16)	56.7	0.04	
Ethnicity	Yes	4	1.10 (1.06-1.15)	10.7	0.34	0.42
	No	4	0.99 (0.78-1.24)	71.7	0.01	
Family history	Yes	7	1.09 (1.03-1.15)	55.9	0.03	0.36
	No	1	0.65 (0.32-1.32)			
Body mass index	Yes	8	1.08 (1.02-1.15)	55.4	0.03	NC
	No	0				
Waist circumference/WHR	Yes	1	0.97 (0.81-1.15)			0.38
	No	7	1.09 (1.03-1.16)	56.1	0.03	
Hypertension	Yes	2	0.93 (0.69-1.27)	28.2	0.24	0.17
	No	6	1.10 (1.05-1.17)	49.2	0.08	
Alcohol	Yes	6	1.08 (1.03-1.14)	44.5	0.11	0.65
	No	2	0.61 (0.14-2.73)	83.7	0.01	
Smoking	Yes	7	1.09 (1.03-1.16)	56.1	0.03	0.38
	No	1	0.97 (0.81-1.15)			
Physical activity	Yes	7	1.07 (1.00-1.14)	59.1	0.02	0.51
	No	1	1.17 (1.02-1.35)			
Meat consumption	Yes	1	0.65 (0.32-1.32)			0.36
	No	7	1.09 (1.03-1.15)	55.9	0.03	
Soft drink	Yes	1	0.65 (0.32-1.32)			0.36
	No	7	1.09 (1.03-1.15)	55.9	0.03	
Whole grain	Yes	2	0.46 (0.19-1.13)	43.1	0.19	0.09
	No	6	1.09 (1.05-1.14)	36.9	0.16	
Coffee	Yes	1	0.65 (0.32-1.32)			0.36
	No	7	1.09 (1.03-1.15)	55.9	0.03	
Energy intake	Yes	8	1.08 (1.02-1.15)	55.4	0.03	NC
	No	0				

n = number of studies
[a] *P* for heterogeneity within each subgroup
[b] *P* for heterogeneity between subgroups with meta-regression analysis
NC not calculatable

Supplemental Table 20. World Cancer Research Fund grading criteria

Grading	Criteria
Convincing	A convincing relationship should be robust enough to be highly unlikely to be modified in the foreseeable future as new evidence accumulates. All of the following are generally required: - Evidence from more than one study type - Evidence from at least two independent cohort studies - No substantial unexplained heterogeneity within or between study types or in different populations relating to the presence or absence of an association, or direction of effect - Good quality studies to exclude with confidence the possibility that the observed association results from random or systematic error, including confounding, measurement error, and selection bias - Presence of a plausible biological gradient in the association. Such a gradient need not be linear or even in the same direction across different levels of exposure, so long as this can be explained plausibly - Strong and plausible experimental evidence, either from human studies or relevant animal models, that typical human exposures can lead to relevant outcomes
Probable	All of the following are generally required: - Evidence from at least two independent cohort studies, or at least five case-control studies - No substantial unexplained heterogeneity within or between study types or in different populations relating to the presence or absence of an association, or direction of effect - Good quality studies to exclude with confidence the possibility that the observed association results from random or systematic error, including confounding, measurement error, and selection bias - Evidence for biological plausibility
Limited - suggestive	All of the following are generally required: - Evidence from at least two independent cohort studies, or at least five case-control studies - The direction of effect is generally consistent though some unexplained heterogeneity may be present - Evidence for biological plausibility

Limited - no conclusion	Evidence is so limited that no firm conclusion can be made, but this does not mean that there is evidence of no relationship. The evidence might be graded "limited - no conclusion" for several reasons: - limited number of studies - inconsistency of direction of effect - poor quality of studies (e.g. lack of adjustment for known confounders) - or any combination of these factors
Substantial effect on risk unlikely	All of the following are generally required: - Evidence from more than one study type - Evidence from at least two independent cohort studies - Summary estimate of effect close to 1.0 for comparison of high versus low exposure categories - No substantial unexplained heterogeneity within or between study types or in different populations - Good quality studies to exclude with confidence the possibility that the absence of association results from random or systematic error, including inadequate power, imprecision or error in exposure measurement, inadequate range of exposure, confounding, and selection bias - Absence of a demonstrable biological gradient (dose response) - Absence of strong and plausible experimental evidence, either from human studies or relevant animal models, that typical human exposures lead to relevant outcomes

Specific upgrading factors:
1) Presence of a plausible biological gradient (dose response) in the association. Such a gradient need not be linear or even in the same direction across the different levels of exposure, so long as this can be explained plausibly.
2) A particularly large summary effect size (an odds ratio or relative risk of 2.0 or more, depending on the unit of exposure) after appropriate control for confounders.
3) Evidence from randomised trials in humans.
4) Evidence from appropriately controlled experiments demonstrating one or more plausible and specific mechanisms actually operating in humans.
5) Robust and reproducible evidence from experimental studies in appropriate animal models showing that typical human exposures can lead to relevant health outcomes.

Supplemental Table 21. Justification for evidence grading for fruit and vegetables and type 2 diabetes

Requirements for grading of convincing	Fruit and vegetables	Fruits	Vegetables
Statistically significant and robust association	Statistically significant weak inverse association for high vs. low analysis, but this is not robust in influence analyses. The linear and nonlinear dose-response analyses show a non-significant inverse association. Three studies only reported dichotomous results and could not be included in the dose-response analyses.	Statistically significant weak inverse association for high vs. low and nonlinear analysis, borderline significant in linear dose-response, but there is strong evidence of nonlinearity. High vs. low analysis is robust in influence analyses.	No significant association in the high vs. low or linear dose-response analysis, but there is evidence of nonlinearity with a significant reduction at an intake of 100-400 g/d. The lack of association in high vs. low and linear dose-response analyses are not driven by any single studies.
Evidence from at least two independent cohort studies	10 studies (high vs. low) 7 studies (dose-response)	20 studies (high vs. low) 19 studies (dose-response)	17 studies (high vs. low) 15 studies (dose-response)
No substantial unexplained heterogeneity within or between study types or in different populations relating to the presence or absence of an association, or direction of effect	There is no heterogeneity in the high vs. low analysis and low heterogeneity in the dose-response analysis. The inverse association in high vs. low analyses persists in several, but not all subgroup analyses.	Low heterogeneity in high vs. low analysis and moderate to high heterogeneity in the linear dose-response analysis. Most studies show risk estimates in the direction of reduced risk for the high vs. low comparison, although only four studies show a statistically significant reduction in risk, but confidence intervals are somewhat wide and overlapping for several studies. No studies show a significant increase in risk.	Moderate to high heterogeneity in the high vs. low and dose-response analyses. Eleven of 17 studies reported risk estimates in the direction of reduced risk, but only two of these are statistically significant. No studies reported a significant increase in risk, although some studies also report relative risks non-significantly above 1.0.
Good quality studies to exclude with confidence the possibility that the observed association results from random or systematic error,	No indication of publication bias Results persisted in several, although not all subgroup analyses. However, there was no indication of between	No indication of publication bias. Results are in general consistent in subgroup analyses, although for some subgroups there is low power due to few studies. There is little	Egger's test was significant for the dose-response analysis, but not for the high vs. low analysis. Subgroup analyses based on high vs. low and dose-response analyses

including confounding, measurement error, and selection bias	subgroup heterogeneity with meta-regression analyses. No studies corrected for measurement error, but one study (EPIC-InterAct) using biomarkers of fruit and vegetable intakes reported substantially stronger associations than FFQ-based fruit and vegetable intakes. All studies excluded prevalent type 2 diabetes cases at baseline. Exposed and non-exposed participants were selected from the same populations.	indication of significant between subgroup heterogeneity. Exceptions are subgroup with adjustment for family history of diabetes, which shows a significant inverse association and the subgroup of studies with adjustment for waist measures of adiposity, which shows no association. However, both general and abdominal adiposity could potentially be mediators. No studies corrected for measurement error, but one study (EPIC-InterAct) using biomarkers of fruit and vegetable intakes reported substantially stronger associations than FFQ-based fruit and vegetable intakes. All studies excluded prevalent type 2 diabetes cases at baseline. Exposed and non-exposed participants were selected from the same populations.	show consistently no significant association. No studies corrected for measurement error, but one study (EPIC-InterAct) using biomarkers of fruit and vegetable intakes reported substantially stronger associations than FFQ-based fruit and vegetable intakes. All studies excluded prevalent type 2 diabetes cases at baseline. Exposed and non-exposed participants were selected from the same populations.
Presence of a plausible biological gradient in the association. Such a gradient need not be linear or even in the same direction across different levels of exposure, so long as this can be explained plausibly	Some indication of a weak dose-response relationship up to 300-500 g/d and the test for nonlinearity is not significant (p=0.13), although there is no further reductions in risk up to 800 g/d.	There is strong evidence of nonlinearity with a reverse J-shaped or U-shaped association. Several subtypes of fruit are inversely associated with type 2 diabetes, while a few fruit subtypes (cantaloupe, watermelon) are slightly positively associated with type 2 diabetes. Although it is not clear whether some of these are due to selective reporting or if there is a real increase in risk, different directions of risk between fruit subtypes could potentially explain the observed U-shaped dose-response relationship.	There is evidence of nonlinearity (p=0.004) and a slight reverse J-shaped or U-shaped association with a significant reduction in risk at intakes of 100-400 g/d, but the association is non-significant at higher intakes.

Strong and plausible experimental evidence, either from human studies or relevant animal models, that typical human exposures can lead to relevant outcomes	Fruits and vegetables are important sources of dietary fiber, for which there is convincing evidence of a protective effect on adiposity and weight gain, which are major risk factors for type 2 diabetes. There is also considerable evidence from observational studies that a high fruit and vegetable intake reduces weight gain and prevents the development of overweight and obesity. Results from randomized trials show weaker associations between fruit and vegetable intake and weight gain, but are of short duration and there may be issues with compliance. Fruits and vegetables have a high content of various antioxidants, flavonoids and phytochemicals that may contribute towards reduced type 2 diabetes risk. Flavonoids have for example in animal and in vitro studies been shown to regulate carbohydrate digestion, insulin secretion, insulin sensitivity, insulin signaling, and glucose uptake in insulin-sensitive issues through various intracellular signaling pathways. Flavonoids may also protect insulin-producing beta-cells from inflammatory cytokine-induced cytotoxicity, promote beta-cell function and viability, and protect beta-cells against apoptosis.	Fruits are an important source of dietary fiber, for which there is convincing evidence of a protective effect on adiposity and weight gain, which are major risk factors for type 2 diabetes. There is also considerable evidence from observational studies that a high fruit intake reduces weight gain and prevents the development of overweight and obesity. Results from randomized trials show weaker associations between fruit intake and weight gain, but are of short duration and there may be issues with compliance. Fruits have a high content of various antioxidants, flavonoids and phytochemicals that may contribute towards reduced type 2 diabetes risk. Flavonoids have for example in animal and in vitro studies been shown to regulate carbohydrate digestion, insulin secretion, insulin sensitivity, insulin signaling, and glucose uptake in insulin-sensitive issues through various intracellular signaling pathways. Flavonoids may also protect insulin-producing beta-cells from inflammatory cytokine-induced cytotoxicity, promote beta-cell function and viability, and protect beta-cells against apoptosis.	Vegetables are important sources of dietary fiber, for which there is convincing evidence of a protective effect on adiposity and weight gain, which are major risk factors for type 2 diabetes. There is also considerable evidence from observational studies that a high vegetable intake reduces weight gain and prevents the development of overweight and obesity. Results from randomized trials show weaker associations between vegetable intake and weight gain, but are of short duration and there may be issues with compliance. Vegetables have a high content of various antioxidants, flavonoids and phytochemicals that may contribute towards reduced type 2 diabetes risk. Flavonoids have for example in animal and in vitro studies been shown to regulate carbohydrate digestion, insulin secretion, insulin sensitivity, insulin signaling, and glucose uptake in insulin-sensitive issues through various intracellular signaling pathways. Flavonoids may also protect insulin-producing beta-cells from inflammatory cytokine-induced cytotoxicity, promote beta-cell function and viability, and protect beta-cells against apoptosis.

Final grading and justification for overall assessment.	Limited-suggestive evidence for reduced risk with higher fruit and vegetable intake. Justification: Primarily based on significant high vs. low analysis and marginally significant nonlinear dose-response analysis. Results are in general consistent across several, but not all subgroups. Low heterogeneity, no publication bias, no indication of selection bias. Biologically plausible mechanisms exist, but a more precise and robust summary estimate and more details on mechanisms could have led to higher grading.	Probable evidence for reduced type 2 diabetes risk with higher fruit intake. Justification: Significant high vs. low and nonlinear dose-response analysis with evidence of nonlinearity (therefore less emphasis on linear dose-response analysis). Low heterogeneity, robust results in many subgroup analyses as well as in influence analyses (high vs. low comparison). No publication, no indication of selection bias. The overall data for fruits are also consistent with the results for several subtypes of fruits, which show inverse associations (although the number of studies is limited). Biologically plausible mechanisms exist, but more details on mechanisms could have led to higher grading.	Limited-no conclusion evidence for reduced risk of type 2 diabetes with higher vegetable intake. Justification: This is largely based on the lack of association in both high vs. low and linear dose-response analysis. Although there is indication of nonlinearity in the nonlinear analysis, and a weak association cannot be excluded, there is insufficient evidence at present for a higher grading. The null results are robust in subgroup and influence analyses. There is some heterogeneity and indication of publication bias in the dose-response analysis, but in sensitivity analyses this is not substantially affecting the results. No indication of selection bias. None of the vegetable subtypes showed significant inverse associations, although power may be low because of a limited number of studies. Biologically plausible mechanisms by which vegetables could reduced type 2 diabetes risk exist.

Supplemental Table 22. Evidence grading for fruit and vegetables and subtypes and type 2 diabetes

	Reduced risk	Increased risk
Convincing	-	-
Probable	Fruits	-
Limited-suggestive	Fruits and vegetables combined, blueberries, prunes, grapes and raisins, apples/pears, apples, grapefruit	Fruit juice, fruit drinks, total potatoes, brussels sprouts, cauliflower, cantaloupe
Limited - no conclusion	Vegetables, peaches/plums/apricots, bananas, berries, oranges, citrus fruits, watermelon, strawberries, 100% fruit juice, boiled potatoes, allium vegetables, yellow vegetables, cruciferous vegetables, green leafy vegetables, mushrooms, kale/mustard/chard greens, broccoli, cabbage, tomatoes	

For fruit and vegetable subtypes these judgments were largely based on the limited number of studies published. A larger number of studies were published on potatoes and fruit juice and fruit drinks, however, results were not robust in influence analyses and across all subgroup analyses, thus further studies are needed before an upgrade of the evidence grading can be made. There is supporting evidence of biological plausibility for several fruit and vegetable subtypes (e.g. blueberries, apples, grapes/raisins, grapefruit, fruit juice, fruit drinks).

Supplemental Figures

Supplemental Figures of subtypes of fruit, high vs. low, linear and nonlinear dose response analyses

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Supplemental Figure 2. Apples and type 2 diabetes, dose-response analysis per 100 g/d
Supplemental Figure 3. Apples and type 2 diabetes, nonlinear dose-response analysis
Supplemental Figure 4. Apples and pears and type 2 diabetes, high vs. low
Supplemental Figure 5. Apples and pears and type 2 diabetes, dose-response analysis per 100 g/d
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Supplemental Figure 15. Blueberries and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 21. Citrus fruits and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 27. Fruit juice and type 2 diabetes, nonlinear dose-response analysis
Supplemental Figure 28. 100% fruit juice and type 2 diabetes, high vs. low
Supplemental Figure 29. 100% fruit juice and type 2 diabetes, dose-response analysis per 250 g/d
Supplemental Figure 30. 100% fruit juice and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 32. Grapefruit and type 2 diabetes, dose-response analysis per 100 g/d
Supplemental Figure 33. Grapefruit and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 35. Grapes and raisins and type 2 diabetes, dose-response analysis per 50 g/d
Supplemental Figure 36. Grapes and raisins and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 39. Oranges and type 2 diabetes, nonlinear dose-response analysis
Supplemental Figure 40. Peaches, plums and apricots and type 2 diabetes, high vs. low

Supplemental Figure 41. Peaches, plums and apricots and type 2 diabetes, dose-response analysis per 100 g/d
Supplemental Figure 42. Peaches, plums and apricots and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 44. Prunes and type 2 diabetes, dose-response analysis per 100 g/d
Supplemental Figure 45. Prunes and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 48. Strawberries and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figures of subtypes of vegetables

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Supplemental Figure 53. Allium vegetables and type 2 diabetes, dose-response analysis per 100 g/d
Supplemental Figure 54. Allium vegetables and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 56. Broccoli and type 2 diabetes, dose-response analysis per 100 g/d
Supplemental Figure 57. Broccoli and type 2 diabetes, nonlinear dose-response analysis
Supplemental Figure 58. Brussels sprouts and type 2 diabetes, high vs. low
Supplemental Figure 59. Brussels sprouts and type 2 diabetes, dose-response analysis per 10 g/d
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Supplemental Figure 66. Cauliflower and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 69. Cruciferous vegetables and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 72. Green leafy vegetables and type 2 diabetes, nonlinear dose-response analysis
Supplemental Figure 73. Kale, mustard and chard greens and type 2 diabetes, high vs. low
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Supplemental Figure 75. Kale, mustard and chard greens and type 2 diabetes, nonlinear dose-response analysis
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Supplemental Figure 81. Potatoes, boiled and type 2 diabetes, nonlinear dose-response analysis
Supplemental Figure 82. Potatoes, total and type 2 diabetes, high vs. low
Supplemental Figure 83. Potatoes, total and type 2 diabetes, dose-response analysis per 100 g/d
Supplemental Figure 84. Potatoes, total and type 2 diabetes, nonlinear dose-response analysis
Supplemental Figure 85. Tomatoes and type 2 diabetes, high vs. low
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Supplemental Figure 92. Influence analysis of fruit and vegetables and type 2 diabetes, dose-response
Supplemental Figure 93. Influence analysis of fruits and type 2 diabetes, high vs. low
Supplemental Figure 94. Influence analysis of fruits and type 2 diabetes, dose-response
Supplemental Figure 95. Influence analysis of vegetables and type 2 diabetes, high vs. low
Supplemental Figure 96. Influence analysis of vegetables and type 2 diabetes, dose-response
Supplemental Figure 97. Influence analysis of cruciferous vegetables and type 2 diabetes, dose-response
Supplemental Figure 98. Influence analysis of fruit drinks and type 2 diabetes, dose-response
Supplemental Figure 99. Influence analysis of green leafy vegetables and type 2 diabetes, dose-response
Supplemental Figure 100. Influence analysis of potatoes, total and type 2 diabetes, dose response

Funnel plots

Supplemental Figure 101. Funnel plot of fruit and vegetables and type 2 diabetes
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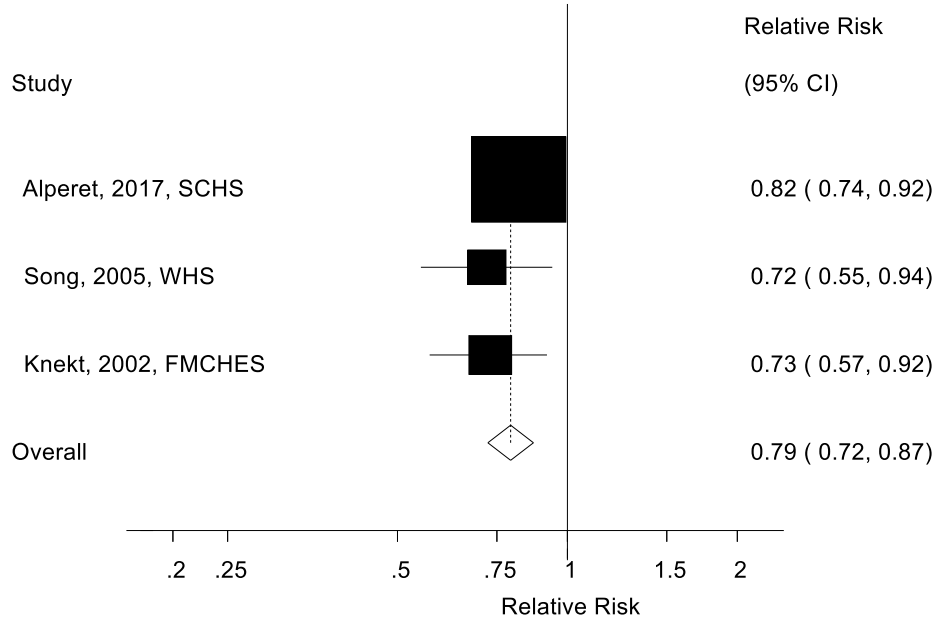
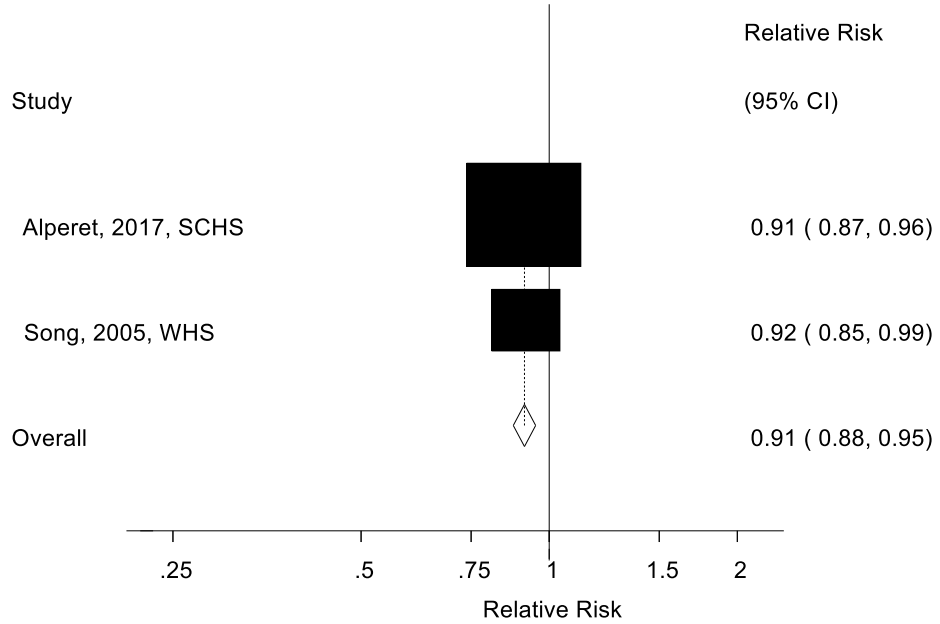
Supplemental Figure 103. Funnel plot of vegetables and type 2 diabetes
Supplemental Figure 104. Funnel plot of cruciferous vegetables and type 2 diabetes
Supplemental Figure 105. Funnel plot of green leafy vegetables and type 2 diabetes
Supplemental Figure 106. Funnel plot of potatoes (total) and type 2 diabetes

Supplemental Figures of subtypes of fruit, high vs. low, linear and nonlinear dose response analyses

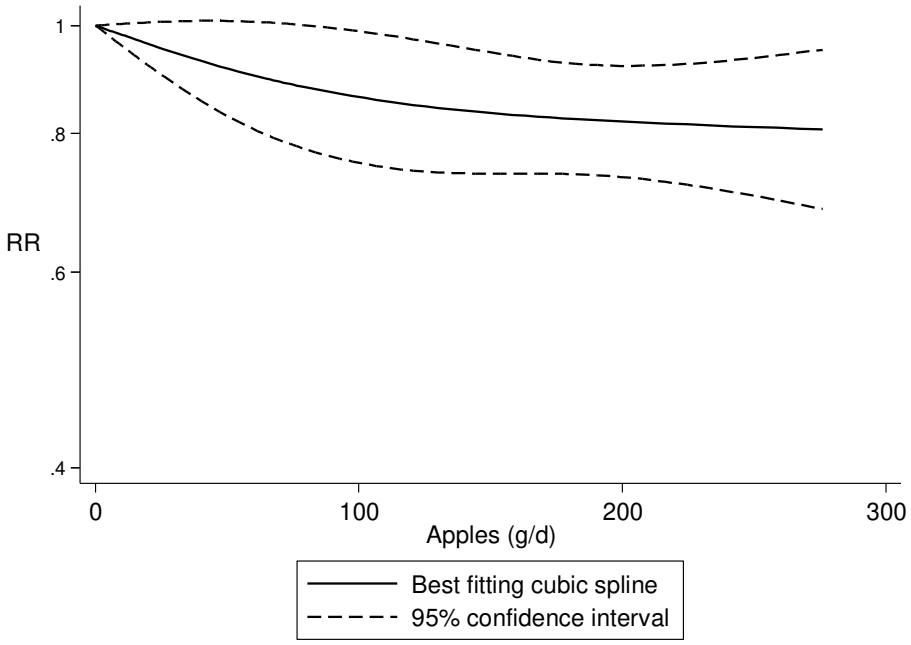
Supplemental Figure 1. Apples and type 2 diabetes, high vs. low



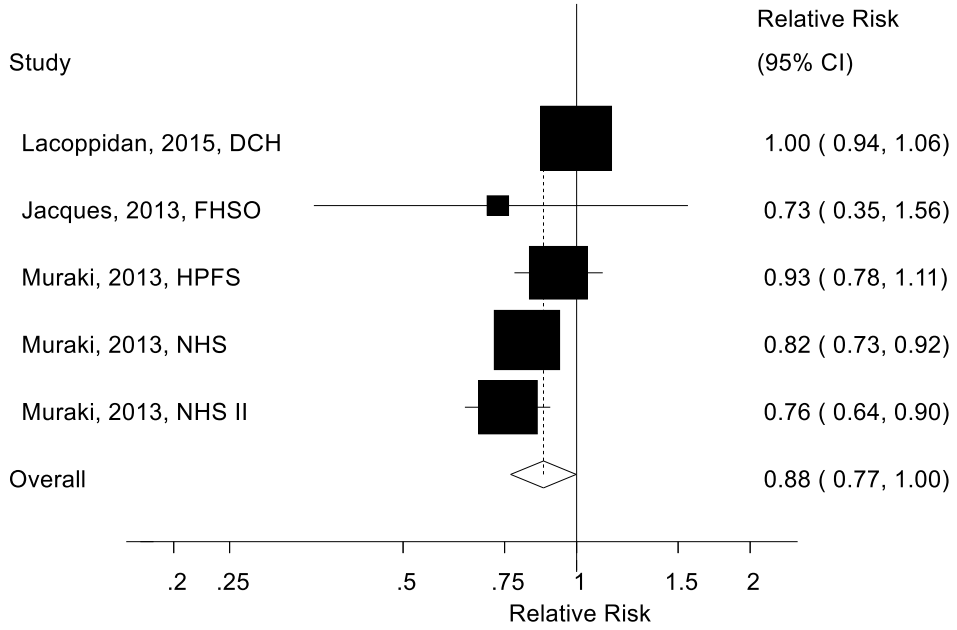
Supplemental Figure 2. Apples and type 2 diabetes, dose-response analysis per 100 g/d



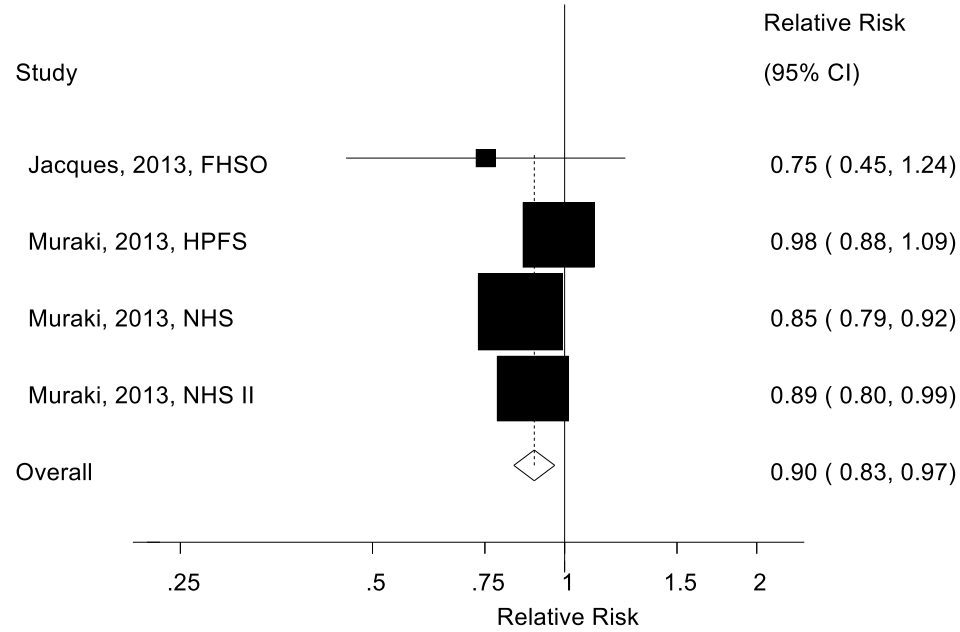
Supplemental Figure 3. Apples and type 2 diabetes, nonlinear dose-response analysis



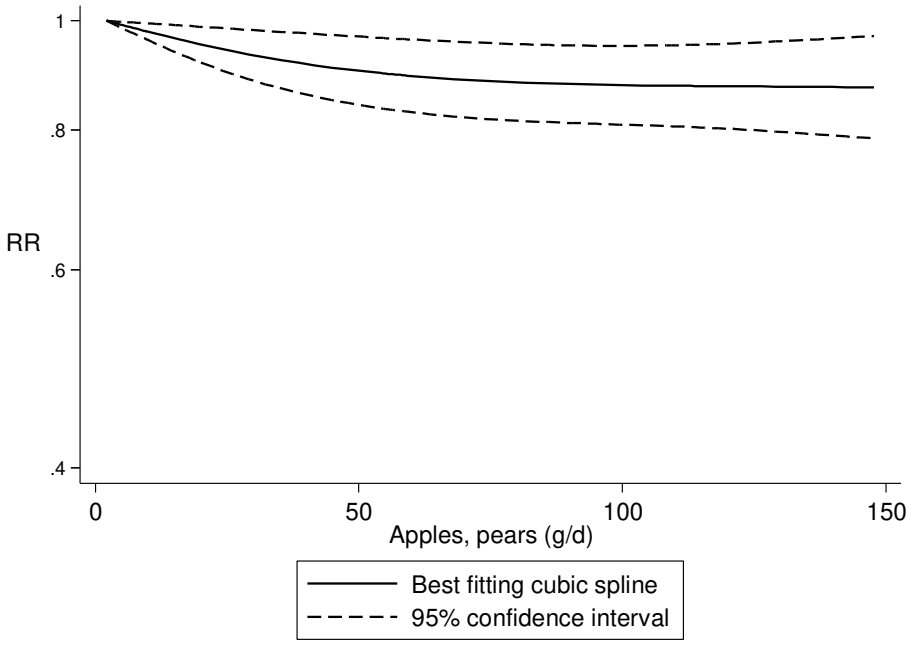
Supplemental Figure 4. Apples and pears and type 2 diabetes, high vs. low



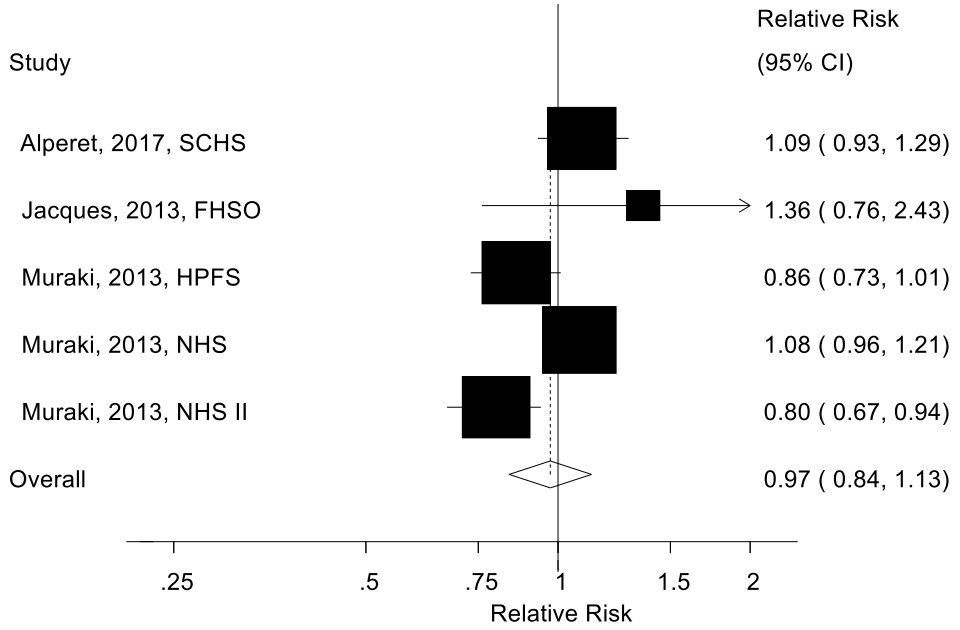
Supplemental Figure 5. Apples and pears and type 2 diabetes, dose-response analysis per 100 g/d



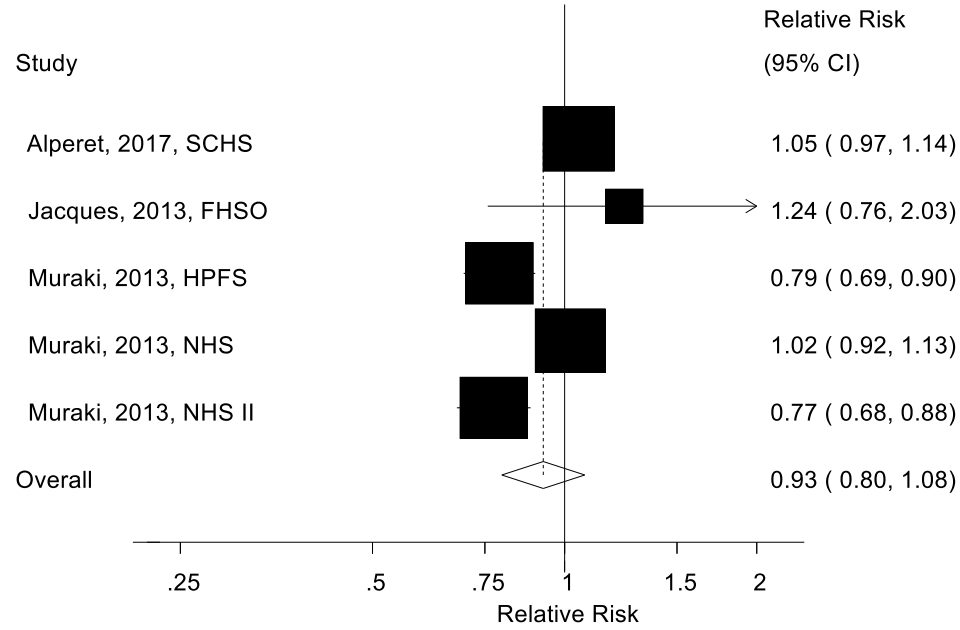
Supplemental Figure 6. Apples and pears and type 2 diabetes, nonlinear dose-response analysis



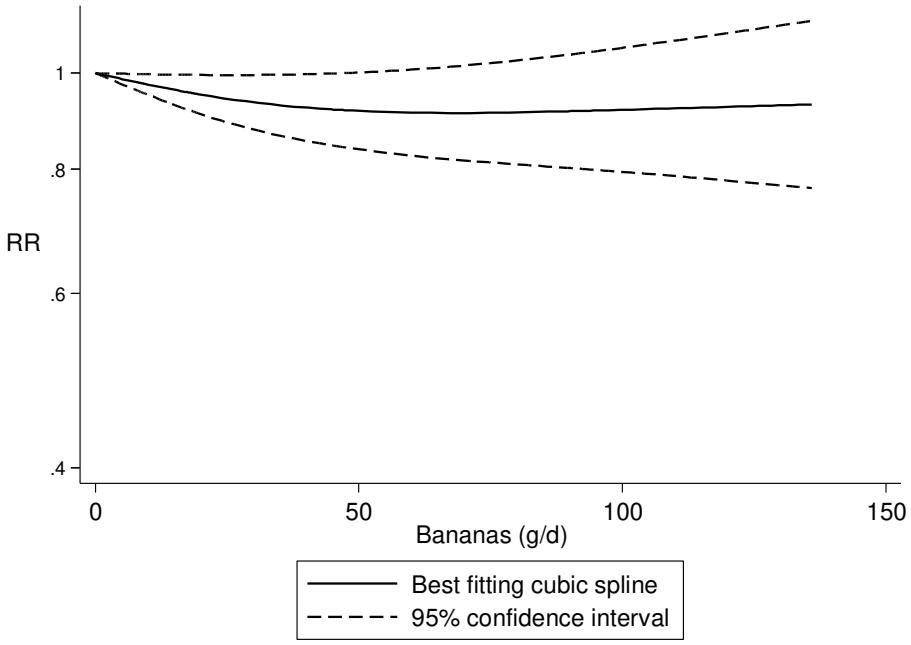
Supplemental Figure 7. Bananas and type 2 diabetes, high vs. low



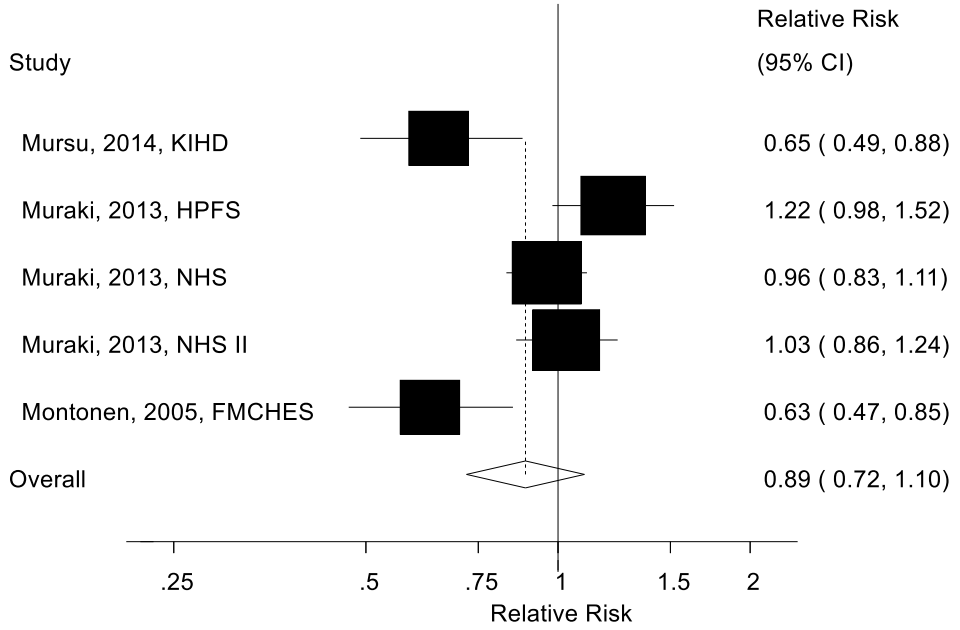
Supplemental Figure 8. Bananas and type 2 diabetes, dose-response analysis per 100 g/d



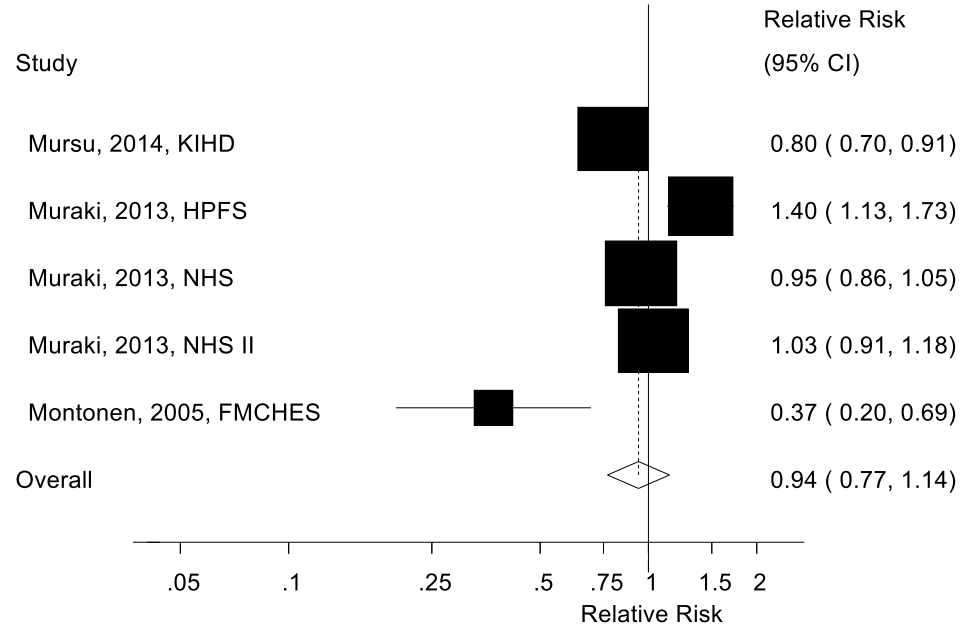
Supplemental Figure 9. Bananas and type 2 diabetes, nonlinear dose-response analysis



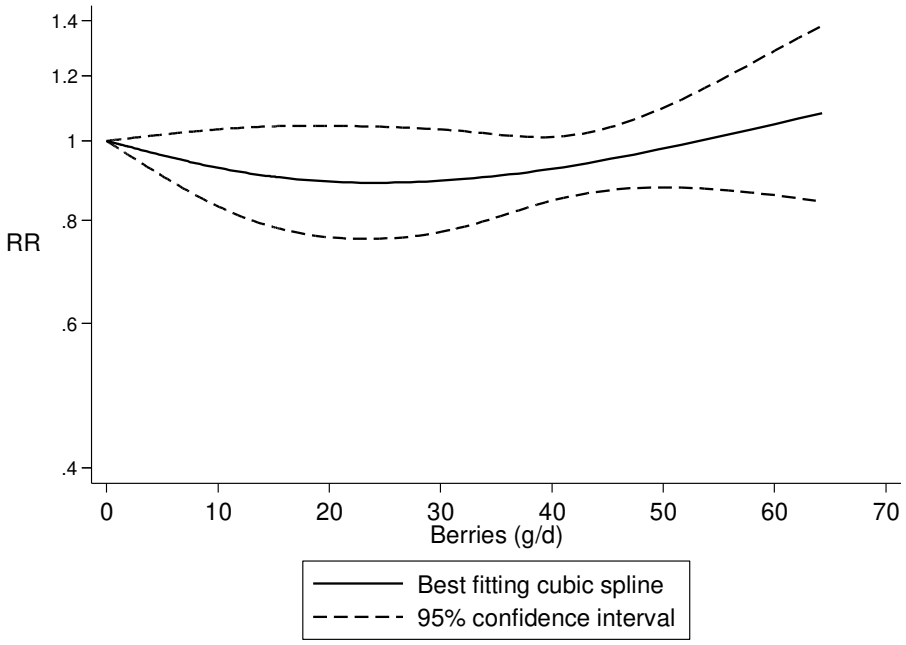
Supplemental Figure 10. Berries and type 2 diabetes, high vs. low



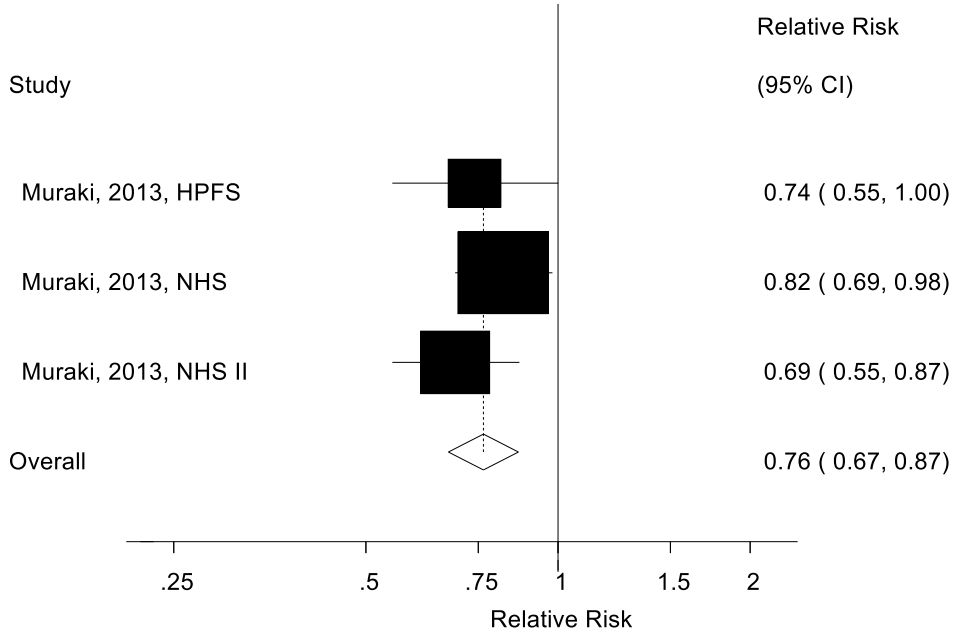
Supplemental Figure 11. Berries and type 2 diabetes, dose-response analysis per 50 g/d



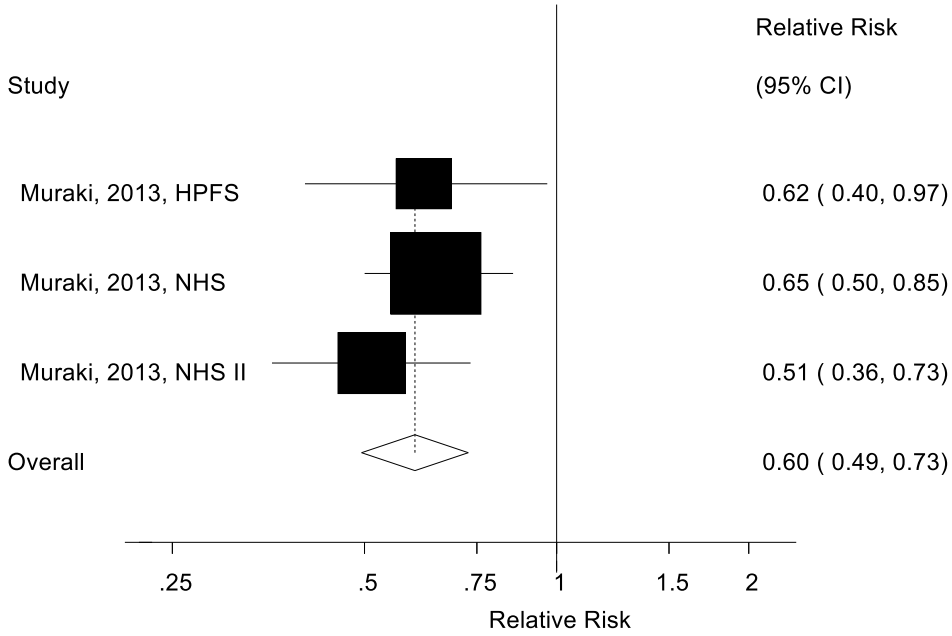
Supplemental Figure 12. Berries and type 2 diabetes, nonlinear dose-response analysis



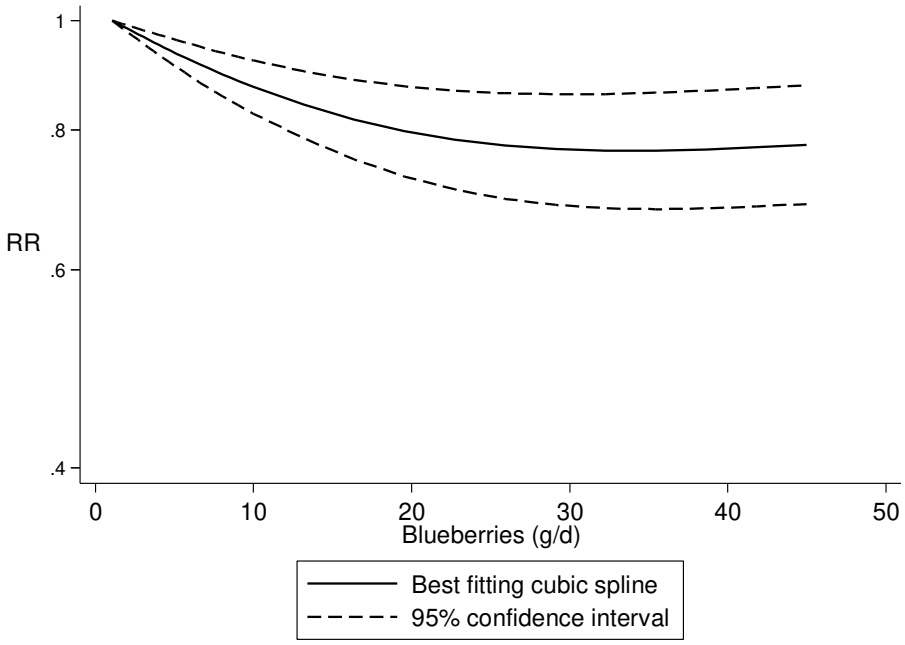
Supplemental Figure 13. Blueberries and type 2 diabetes, high vs. low



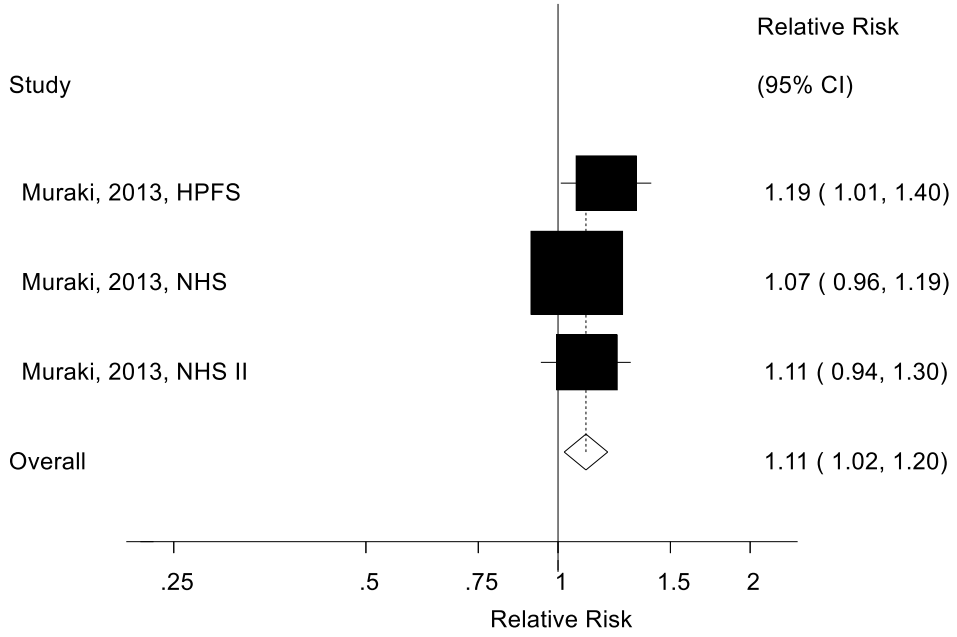
Supplemental Figure 14. Blueberries and type 2 diabetes, dose-response analysis per 50 g/d



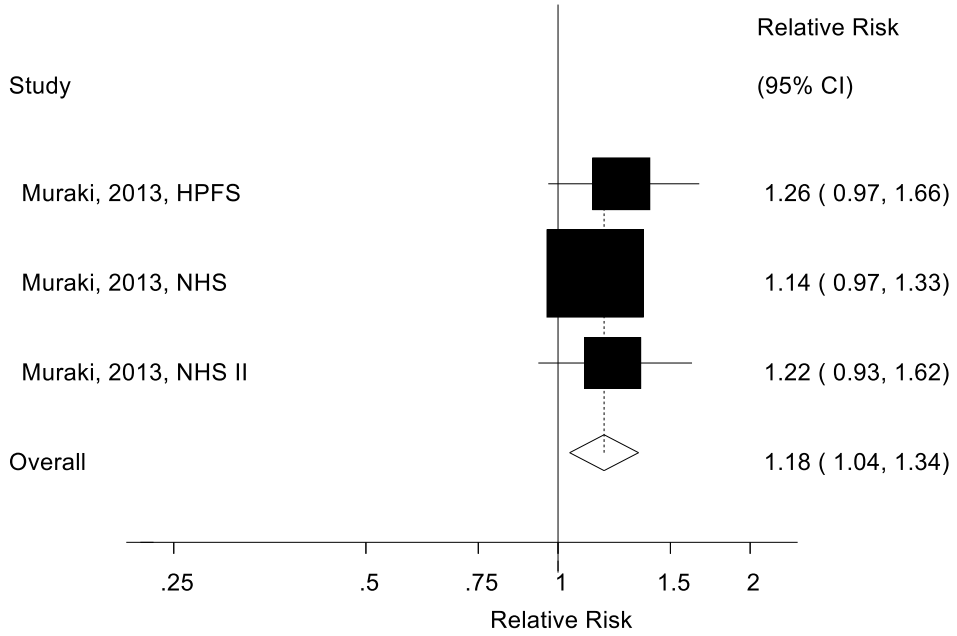
Supplemental Figure 15. Blueberries and type 2 diabetes, nonlinear dose-response analysis



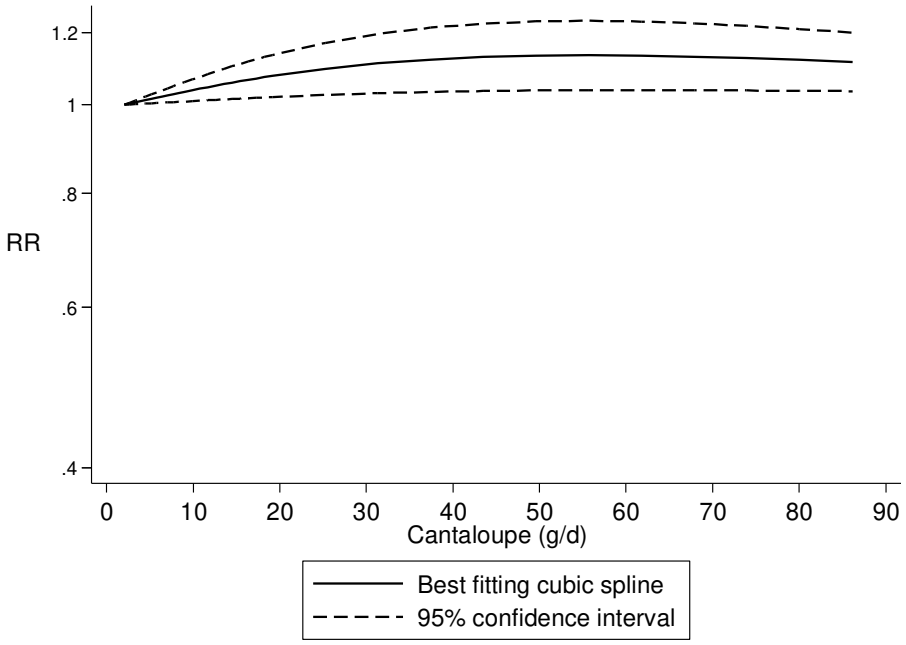
Supplemental Figure 16. Cantaloupe and type 2 diabetes, high vs. low



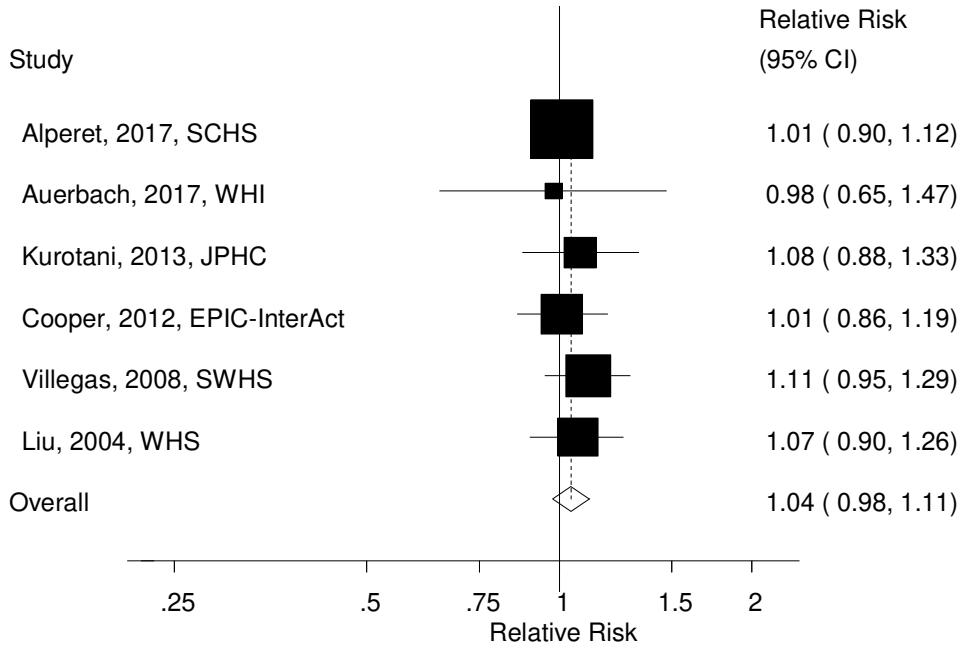
Supplemental Figure 17. Cantaloupe and type 2 diabetes, dose-response analysis per 100 g/d



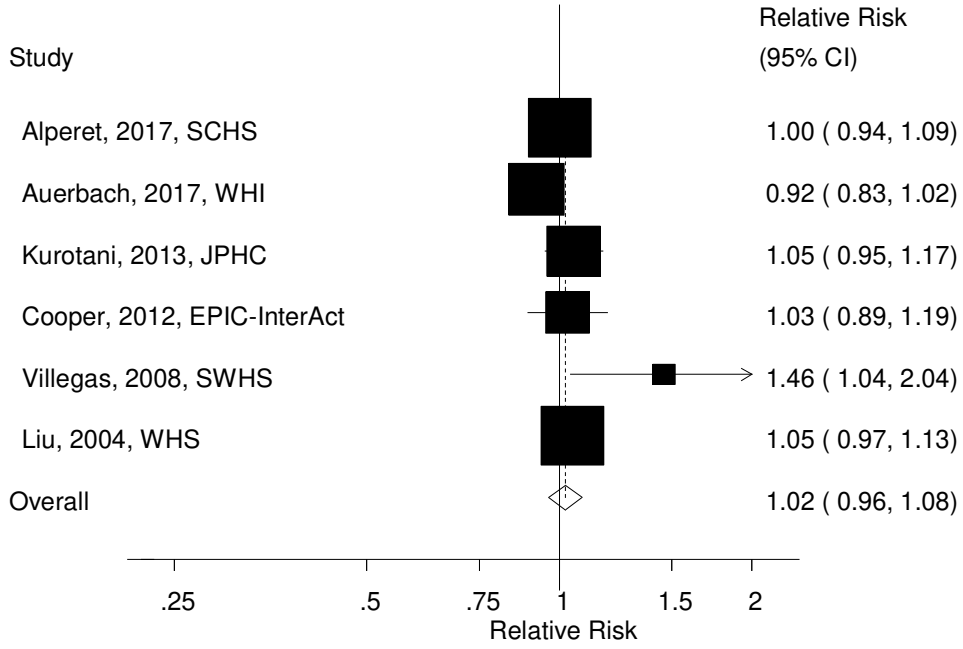
Supplemental Figure 18. Cantaloupe and type 2 diabetes, nonlinear dose-response analysis



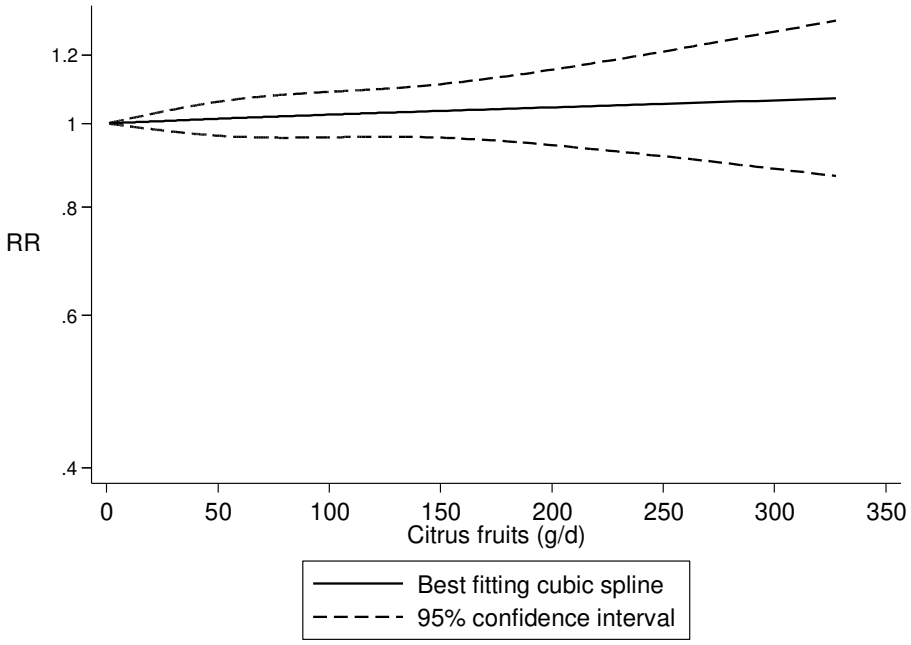
Supplemental Figure 19. Citrus fruits and type 2 diabetes, high vs. low



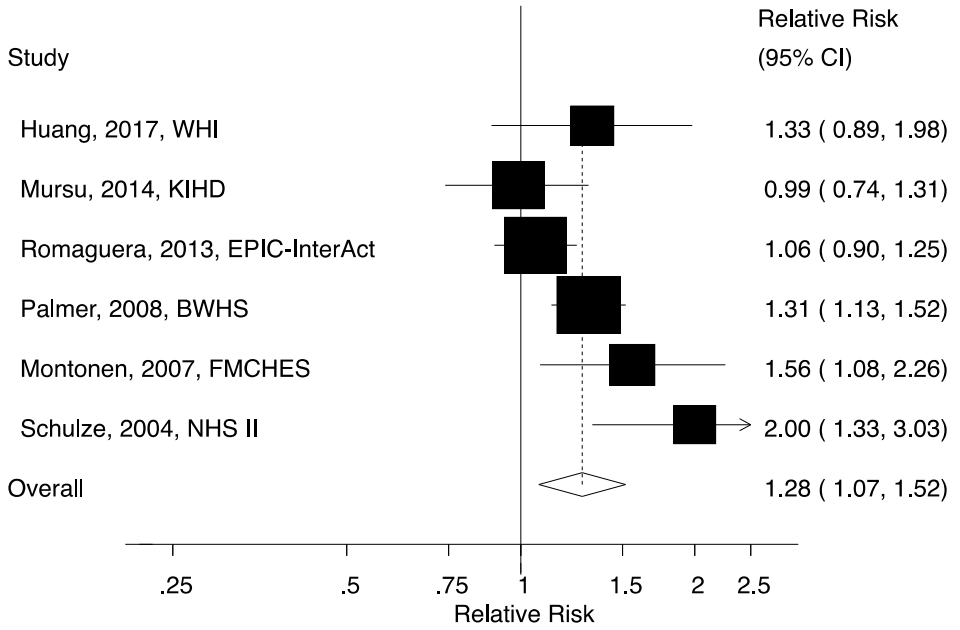
Supplemental Figure 20. Citrus fruits and type 2 diabetes, dose-response analysis per 100 g/d



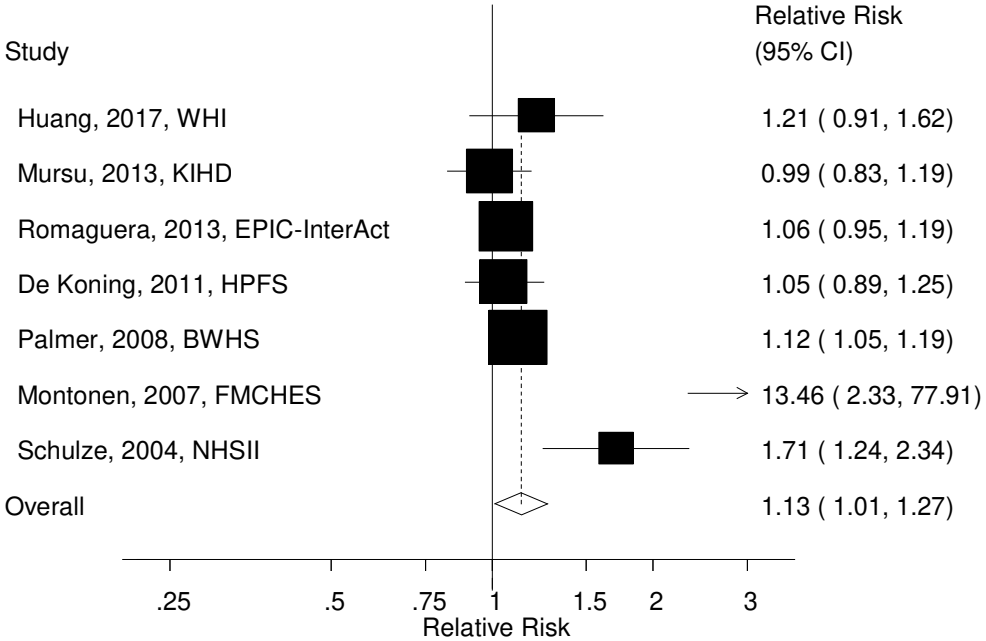
Supplemental Figure 21. Citrus fruits and type 2 diabetes, nonlinear dose-response analysis



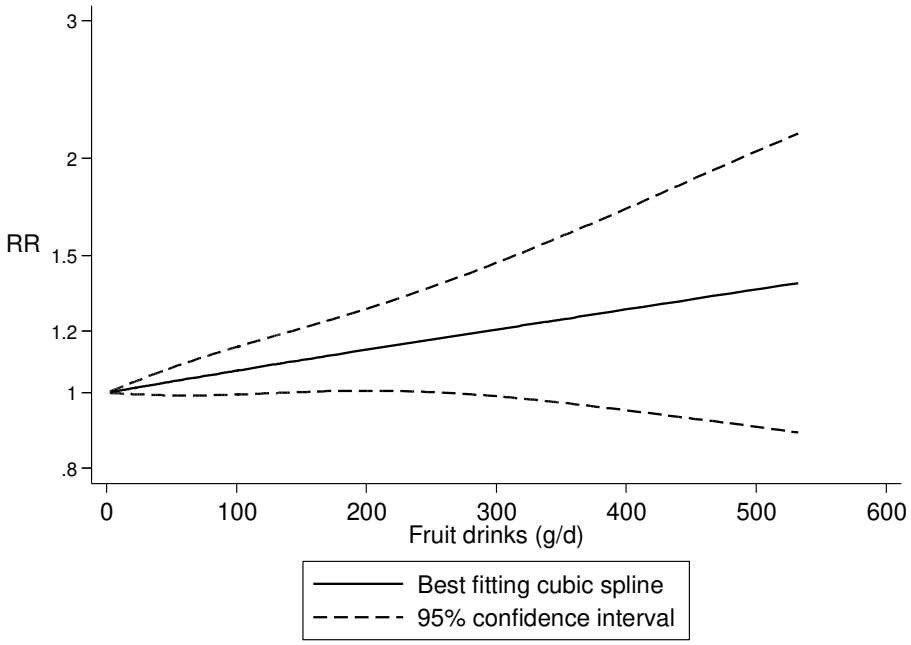
Supplemental Figure 22. Fruit drinks and type 2 diabetes, high vs. low



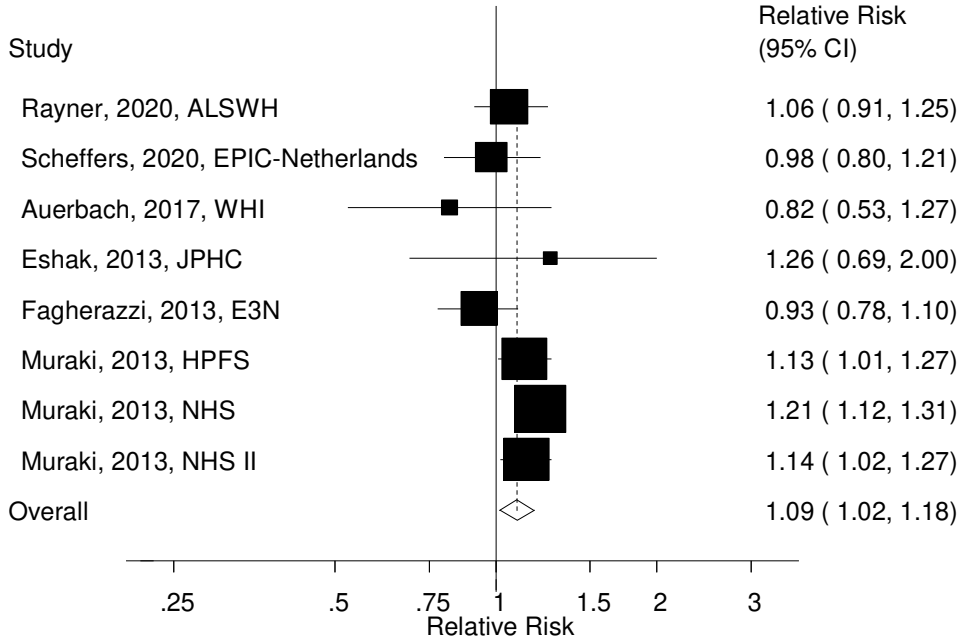
Supplemental Figure 23. Fruit drinks and type 2 diabetes, dose-response analysis per 250 g/d



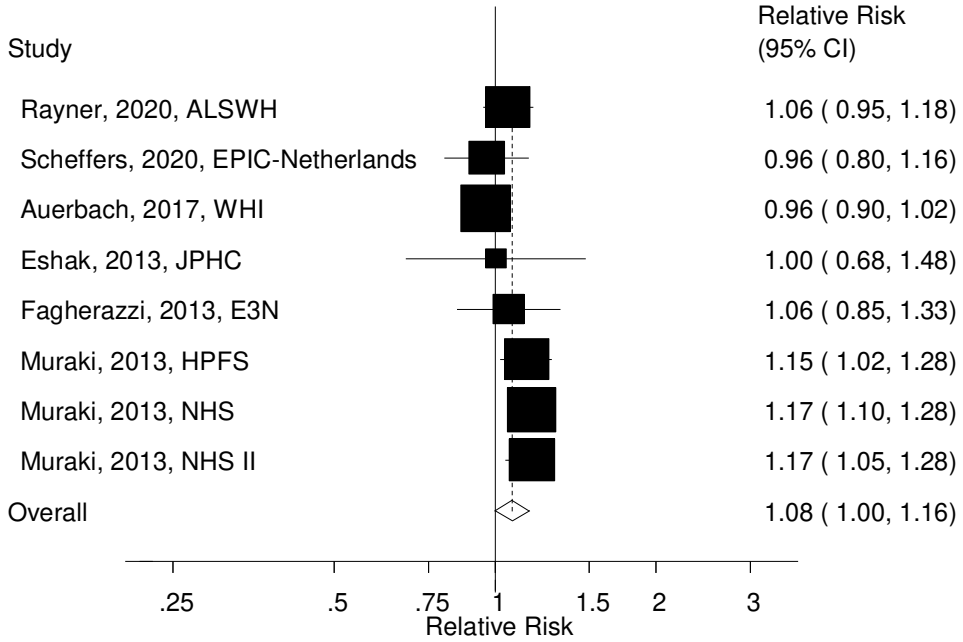
Supplemental Figure 24. Fruit drinks and type 2 diabetes, nonlinear dose-response analysis



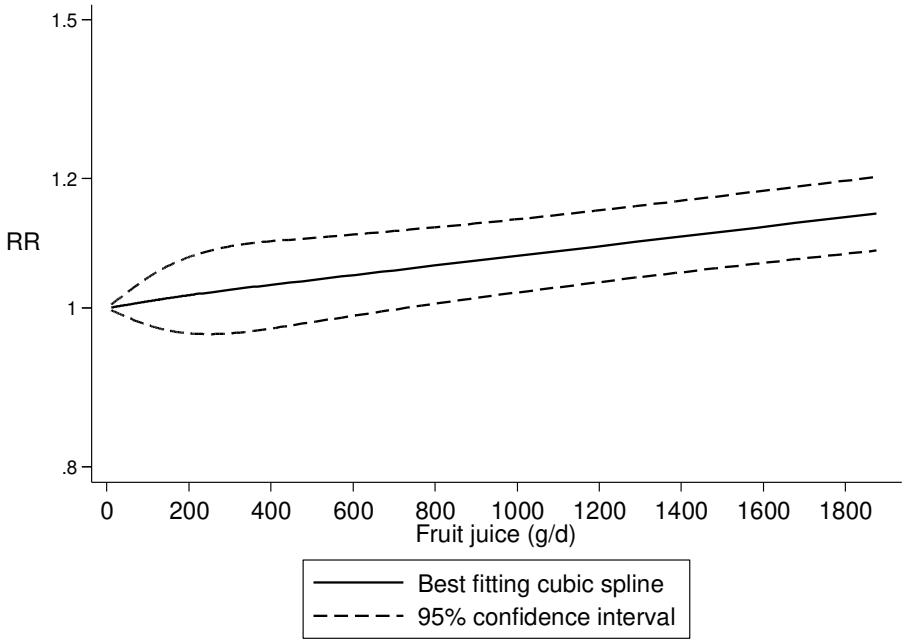
Supplemental Figure 25. Fruit juice and type 2 diabetes, high vs. low



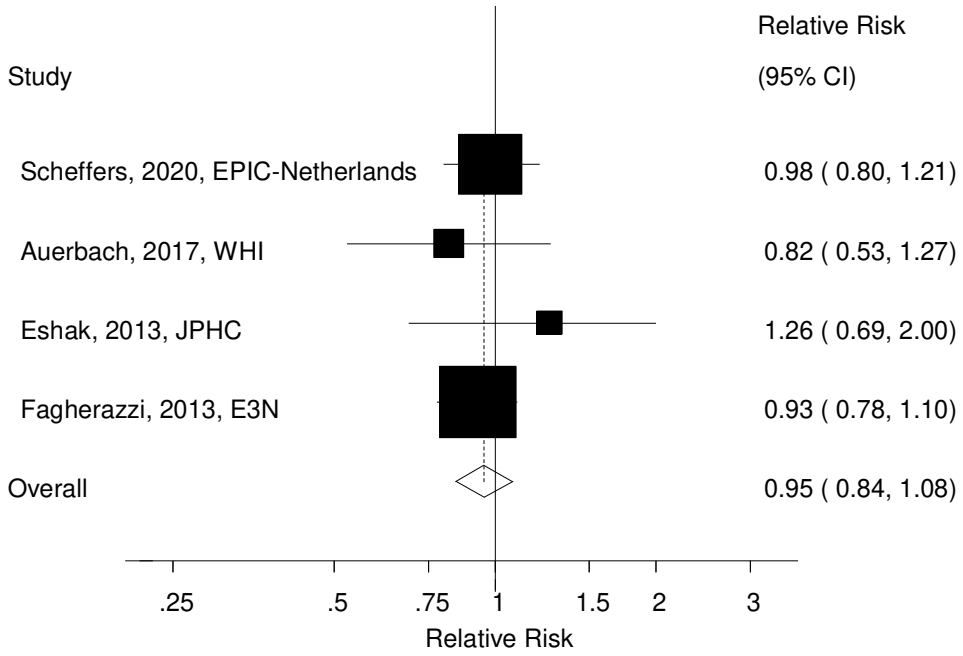
Supplemental Figure 26. Fruit juice and type 2 diabetes, dose-response analysis per 250 g/d



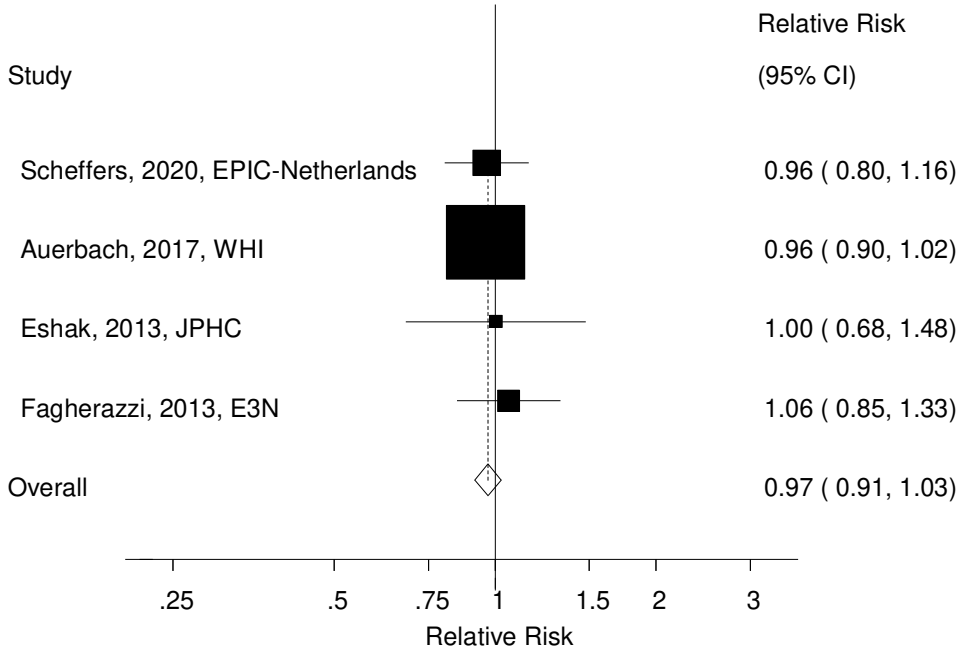
Supplemental Figure 27. Fruit juice and type 2 diabetes, nonlinear dose-response analysis



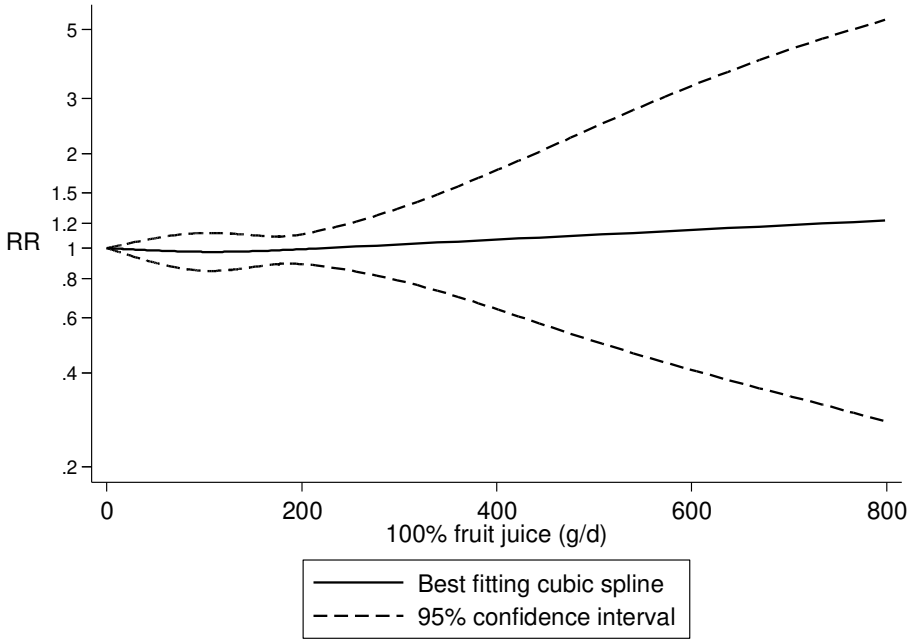
Supplemental Figure 28. 100% fruit juice and type 2 diabetes, high vs. low



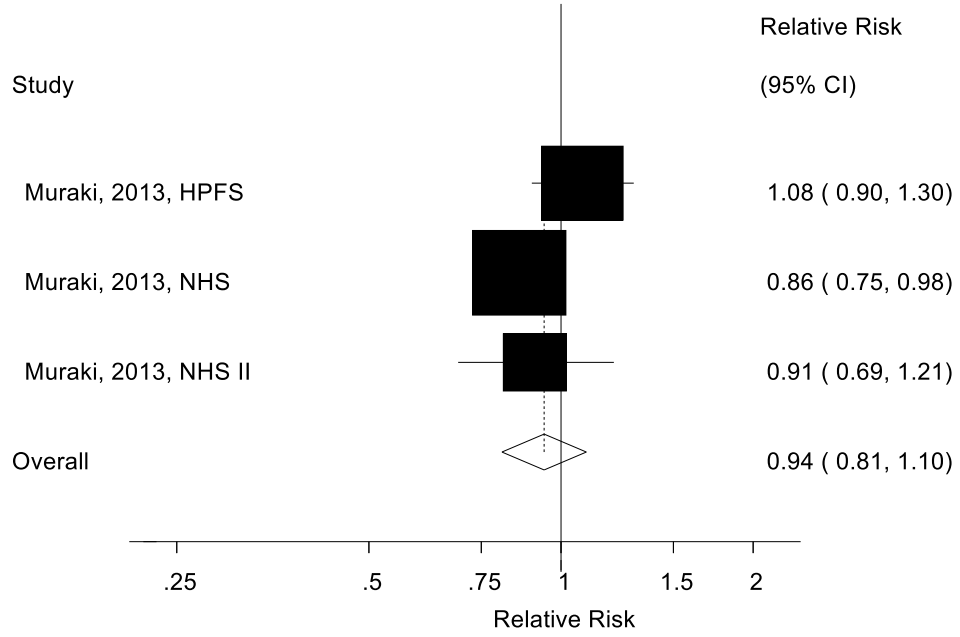
Supplemental Figure 29. 100% fruit juice and type 2 diabetes, dose-response analysis per 250 g/d



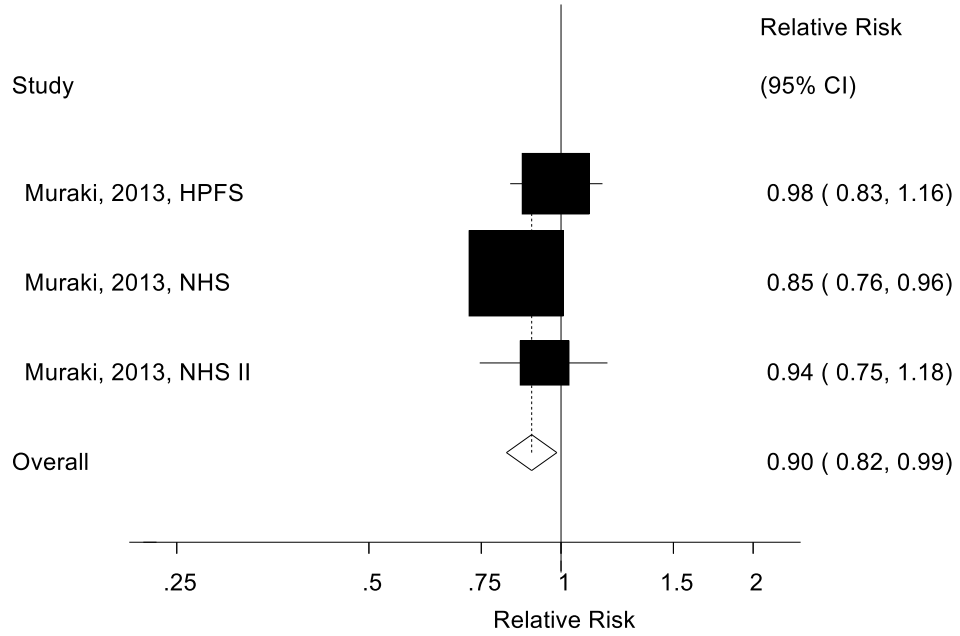
Supplemental Figure 30. 100% fruit juice and type 2 diabetes, nonlinear dose-response analysis



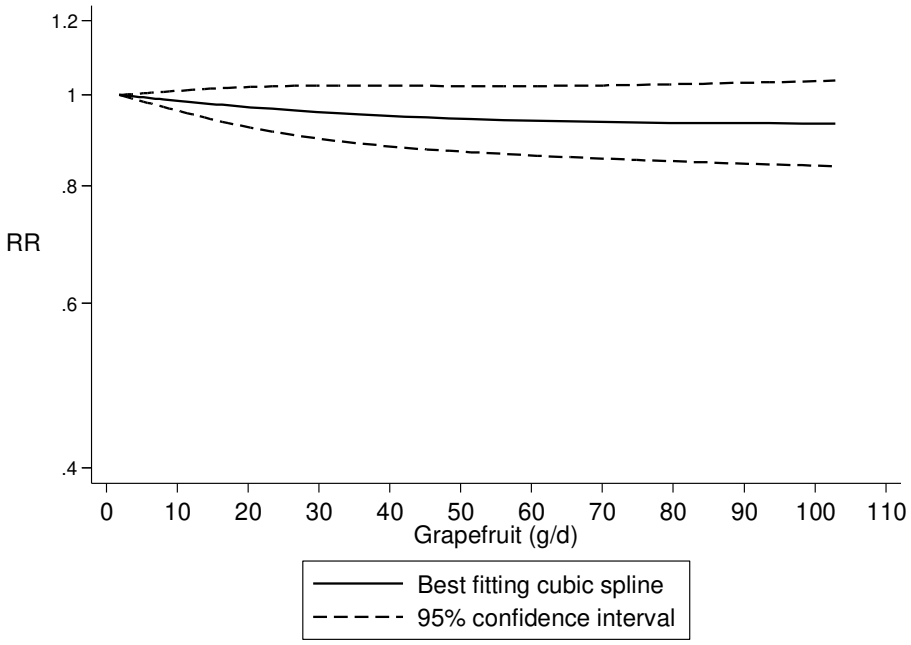
Supplemental Figure 31. Grapefruit and type 2 diabetes, high vs. low



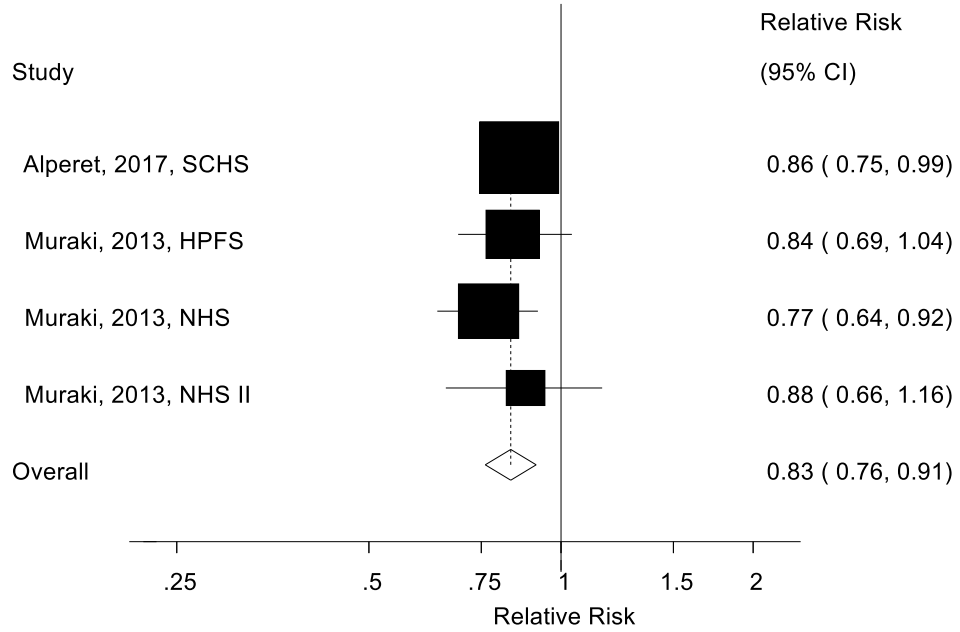
Supplemental Figure 32. Grapefruit and type 2 diabetes, dose-response analysis per 100 g/d



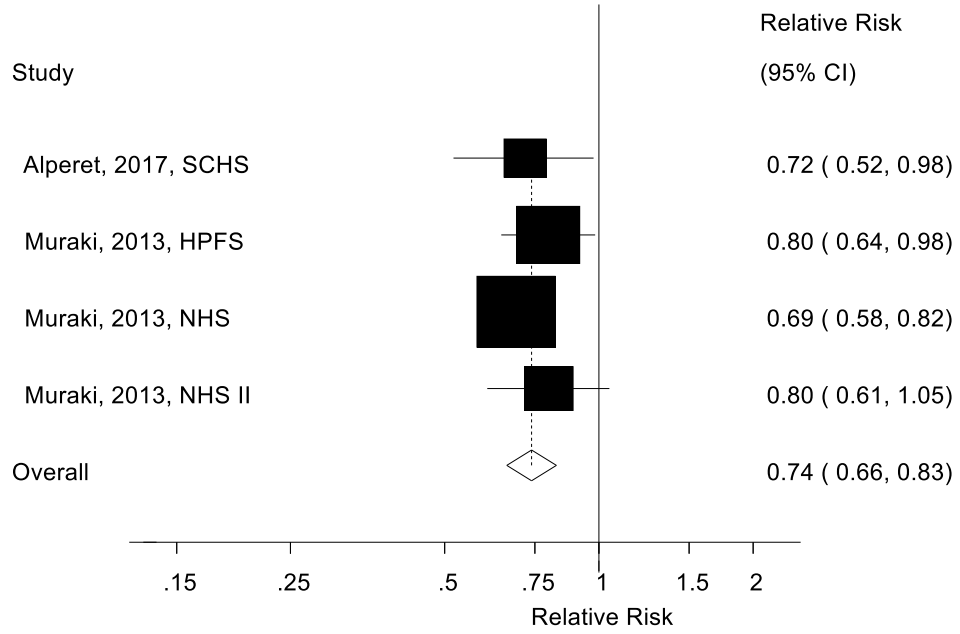
Supplemental Figure 33. Grapefruit and type 2 diabetes, nonlinear dose-response analysis



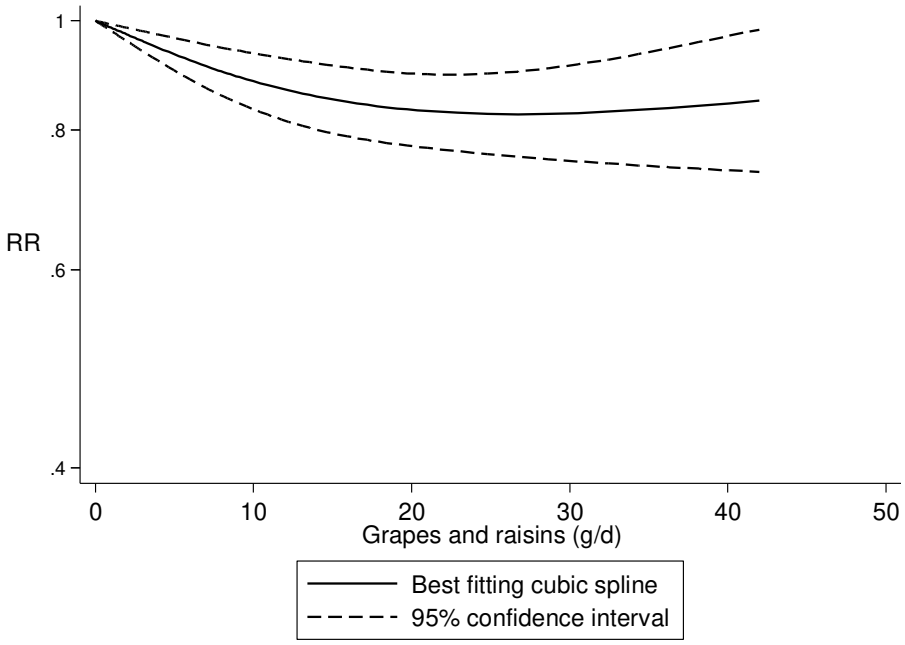
Supplemental Figure 34. Grapes and raisins and type 2 diabetes, high vs. low



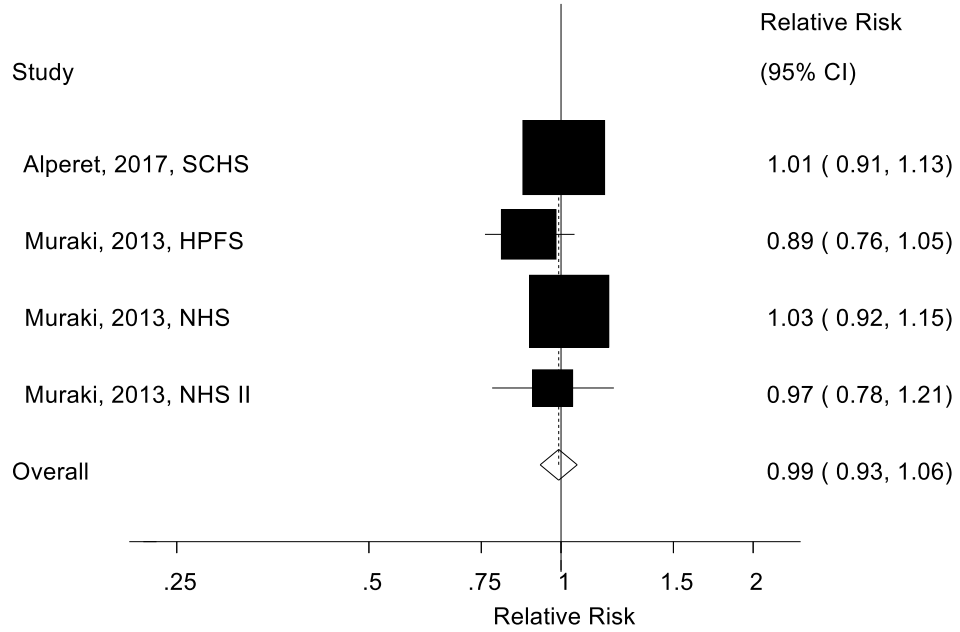
Supplemental Figure 35. Grapes and raisins and type 2 diabetes, dose-response analysis per 50 g/d



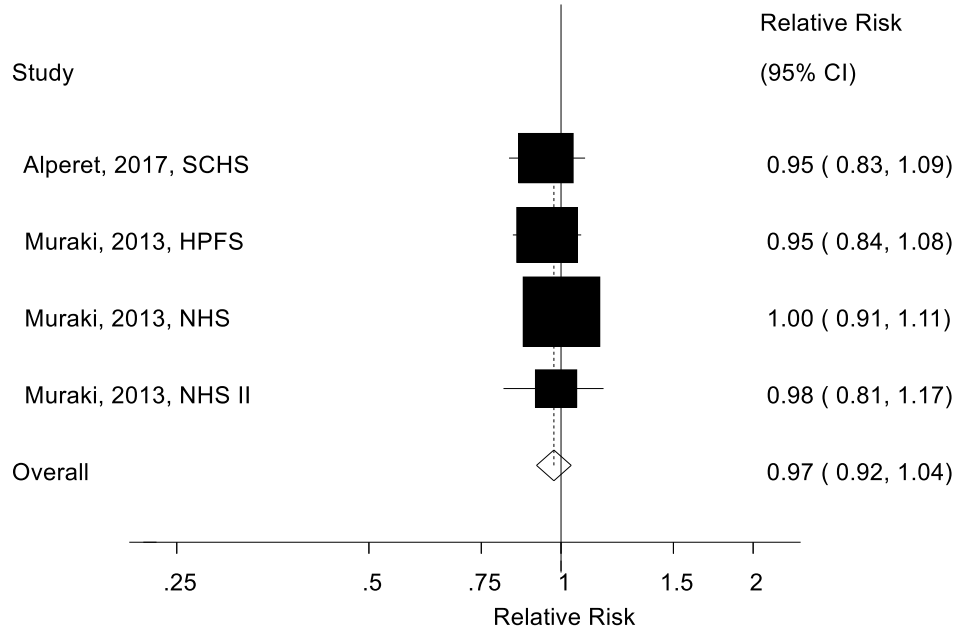
Supplemental Figure 36. Grapes and raisins and type 2 diabetes, nonlinear dose-response analysis



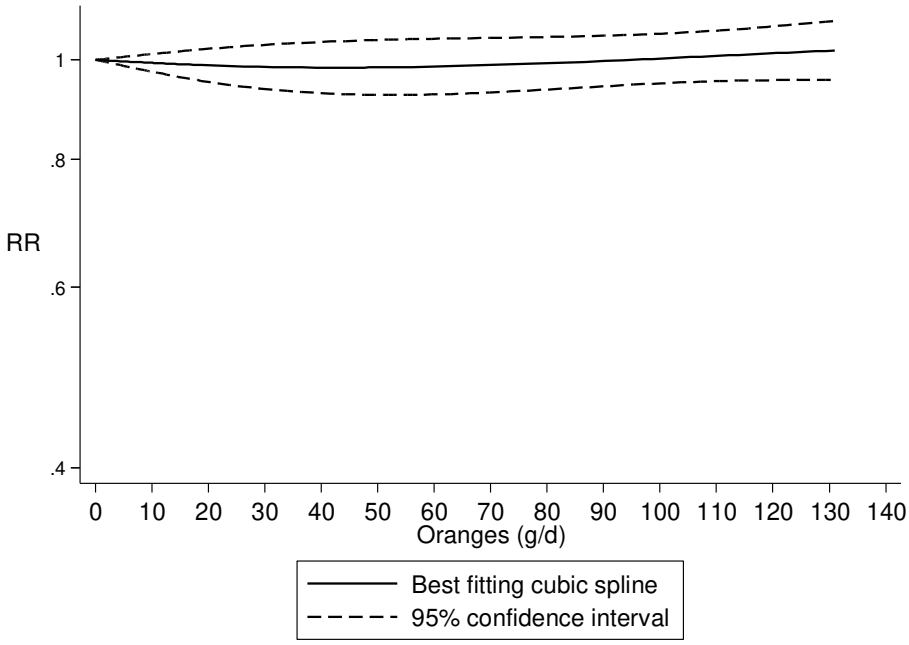
Supplemental Figure 37. Oranges and type 2 diabetes, high vs. low



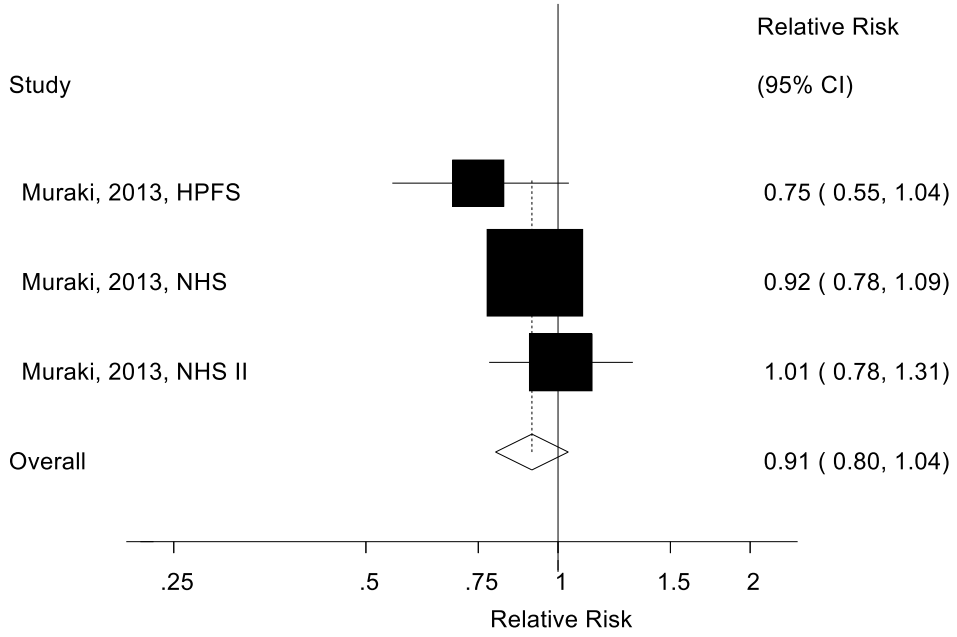
Supplemental Figure 38. Oranges and type 2 diabetes, dose-response analysis per 100 g/d



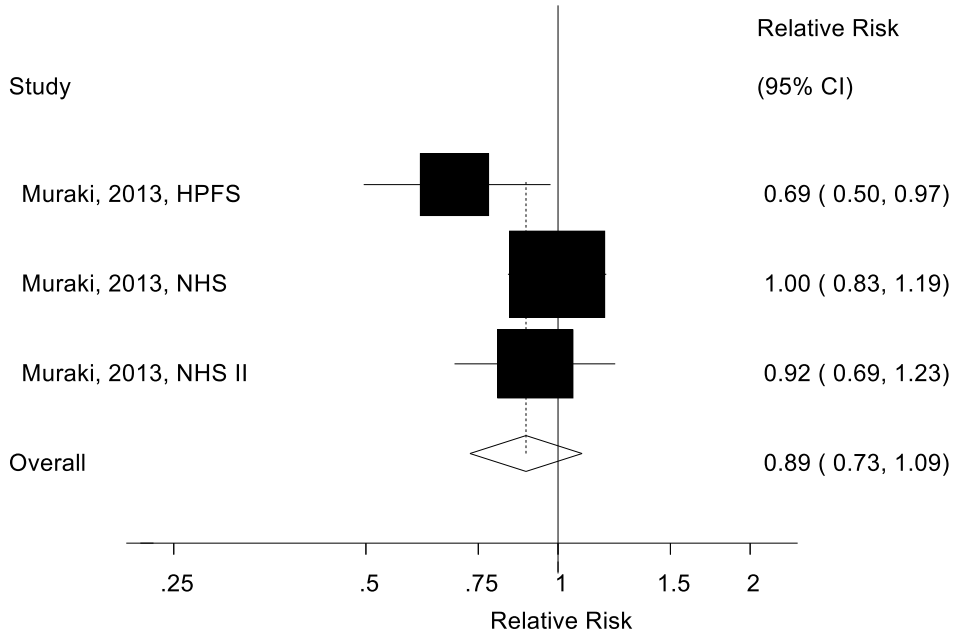
Supplemental Figure 39. Oranges and type 2 diabetes, nonlinear dose-response analysis



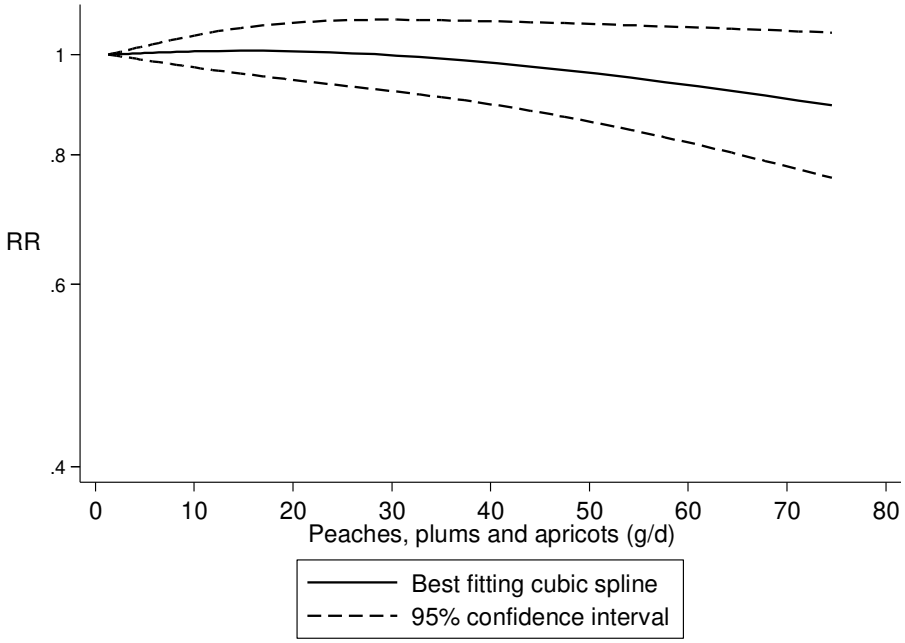
Supplemental Figure 40. Peaches, plums and apricots and type 2 diabetes, high vs. low



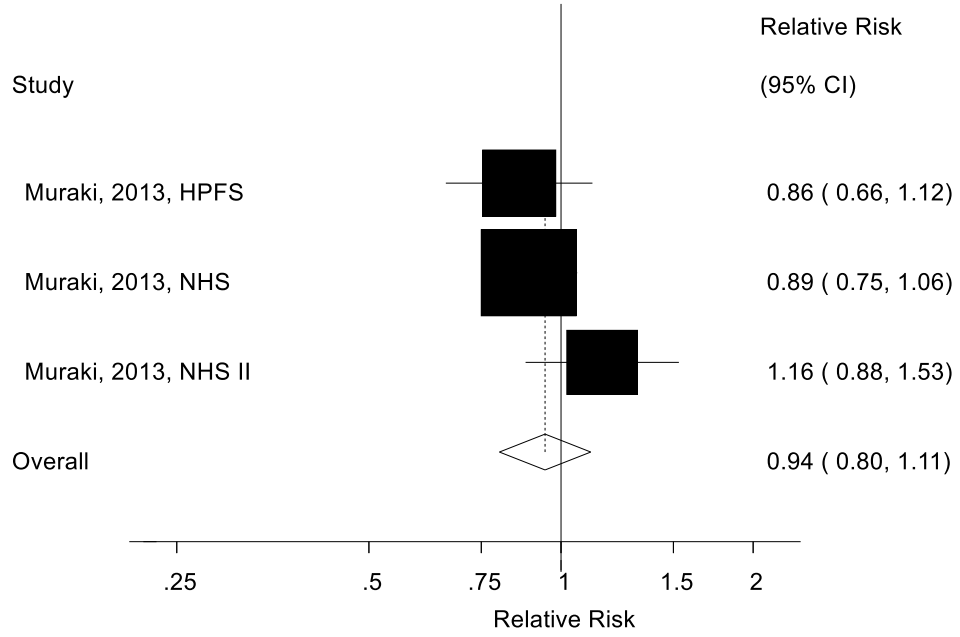
Supplemental Figure 41. Peaches, plums and apricots and type 2 diabetes, dose-response analysis per 100 g/d



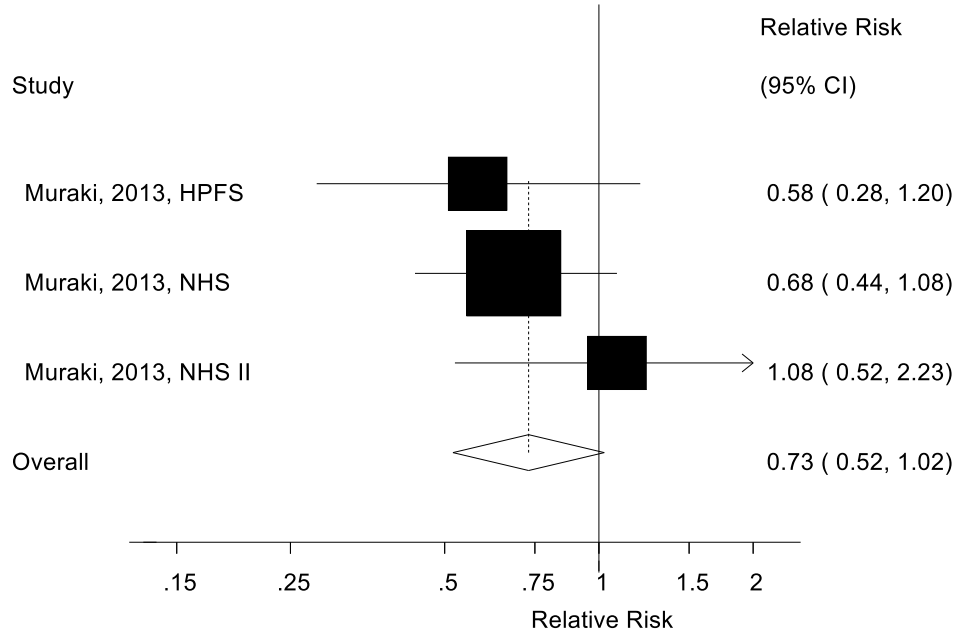
Supplemental Figure 42. Peaches, plums and apricots and type 2 diabetes, nonlinear dose-response analysis



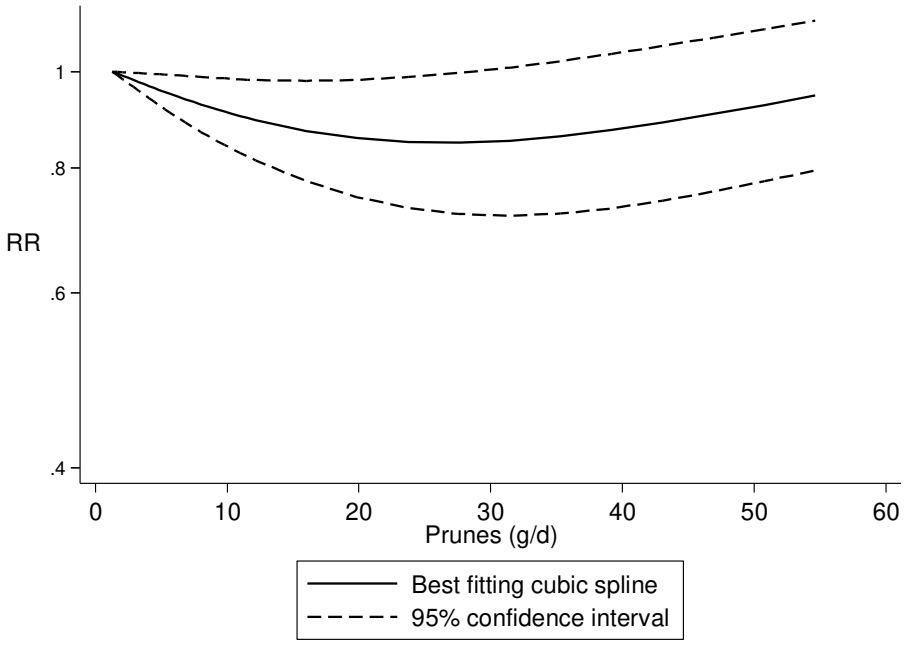
Supplemental Figure 43. Prunes and type 2 diabetes, high vs. low



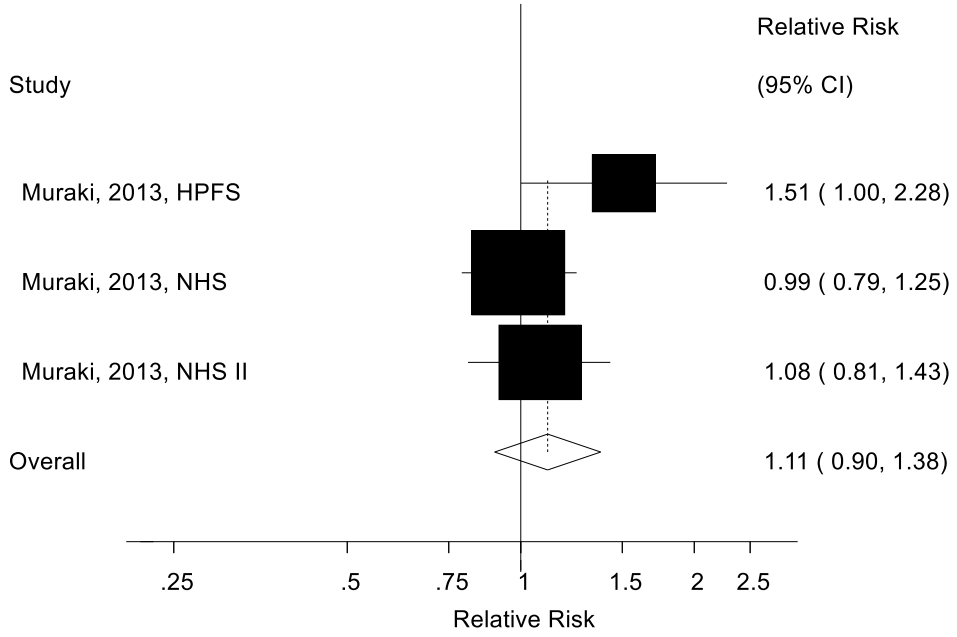
Supplemental Figure 44. Prunes and type 2 diabetes, dose-response analysis per 100 g/d



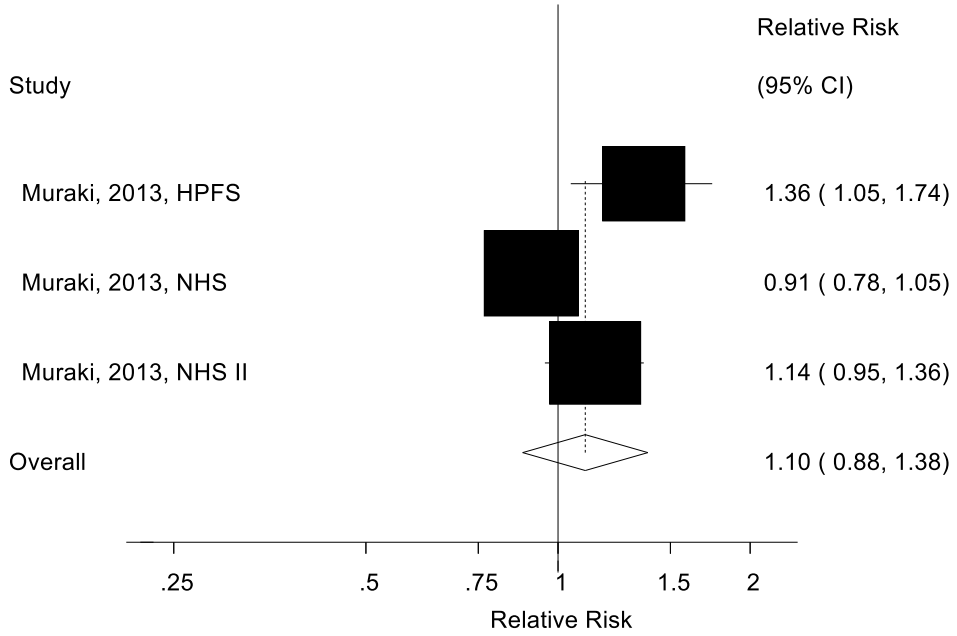
Supplemental Figure 45. Prunes and type 2 diabetes, nonlinear dose-response analysis



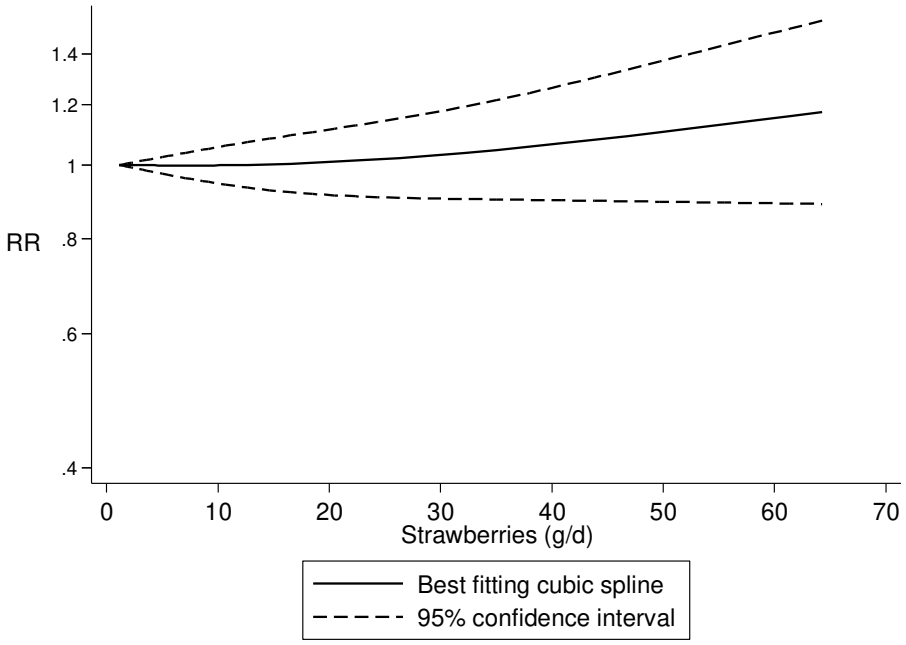
Supplemental Figure 46. Strawberries and type 2 diabetes, high vs. low



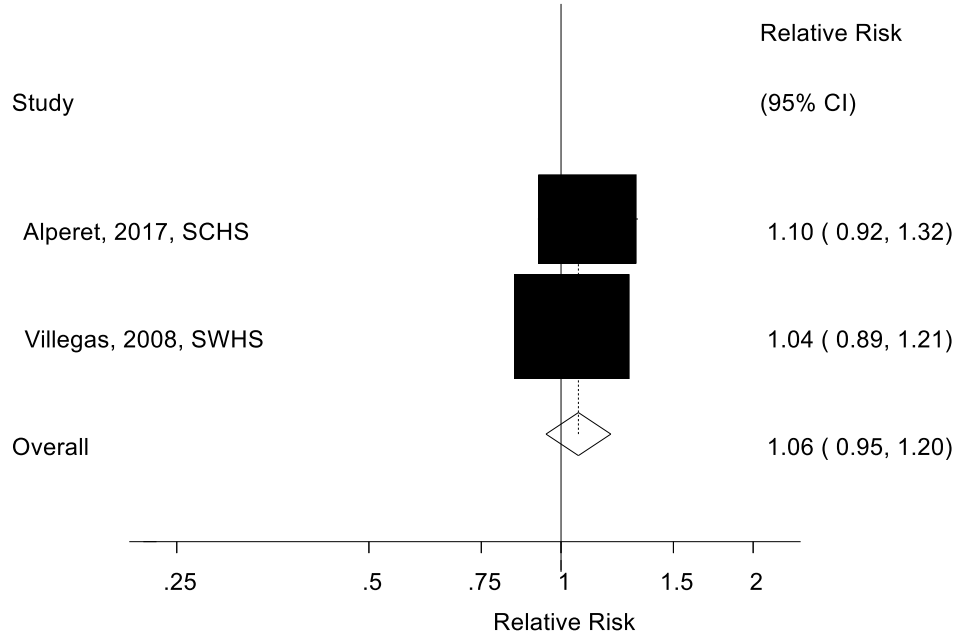
Supplemental Figure 47. Strawberries and type 2 diabetes, dose-response analysis per 50 g/d



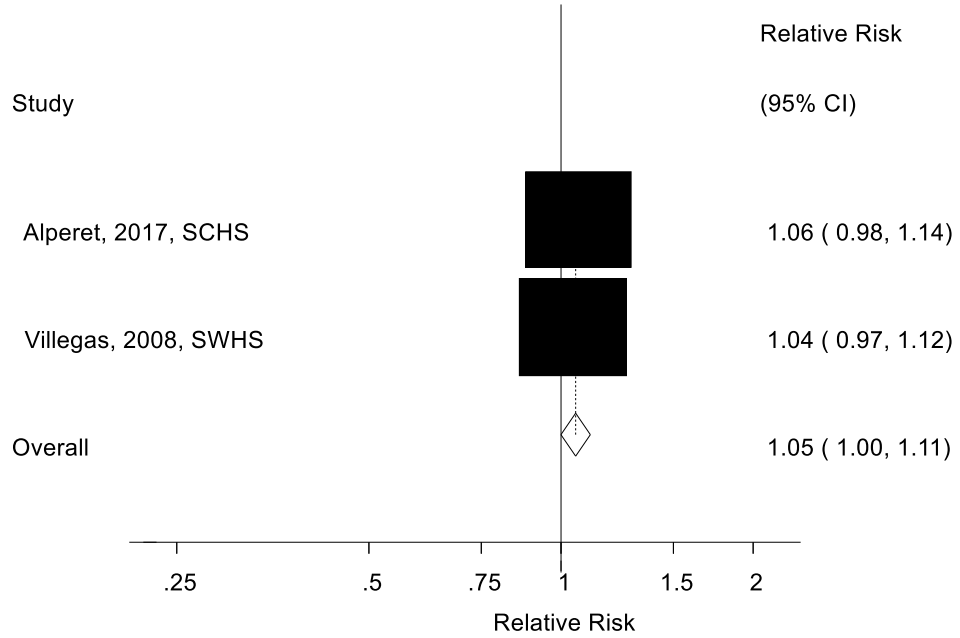
Supplemental Figure 48. Strawberries and type 2 diabetes, nonlinear dose-response analysis



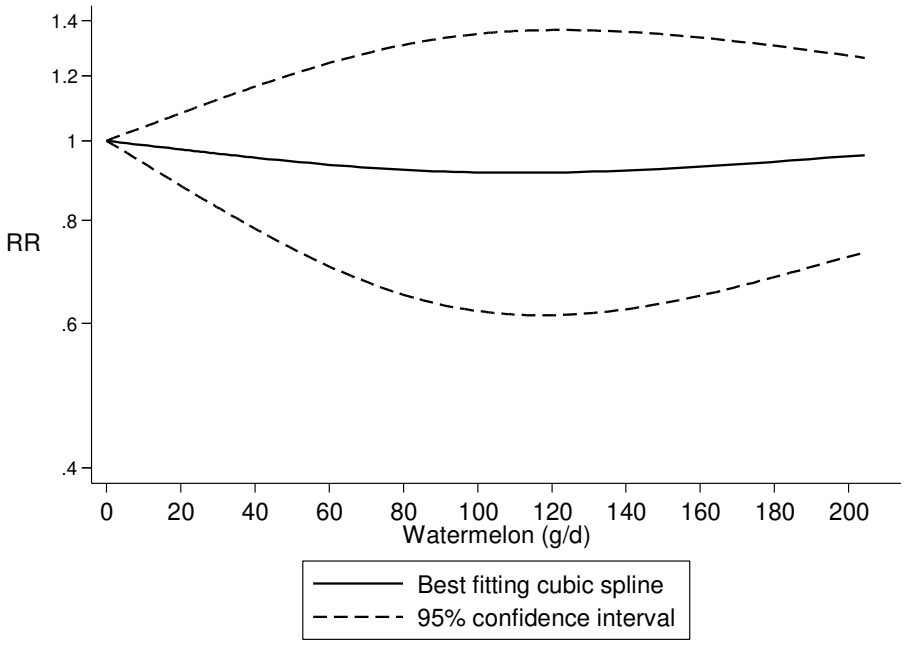
Supplemental Figure 49. Watermelon and type 2 diabetes, high vs. low



Supplemental Figure 50. Watermelon and type 2 diabetes, dose-response analysis per 100 g/d

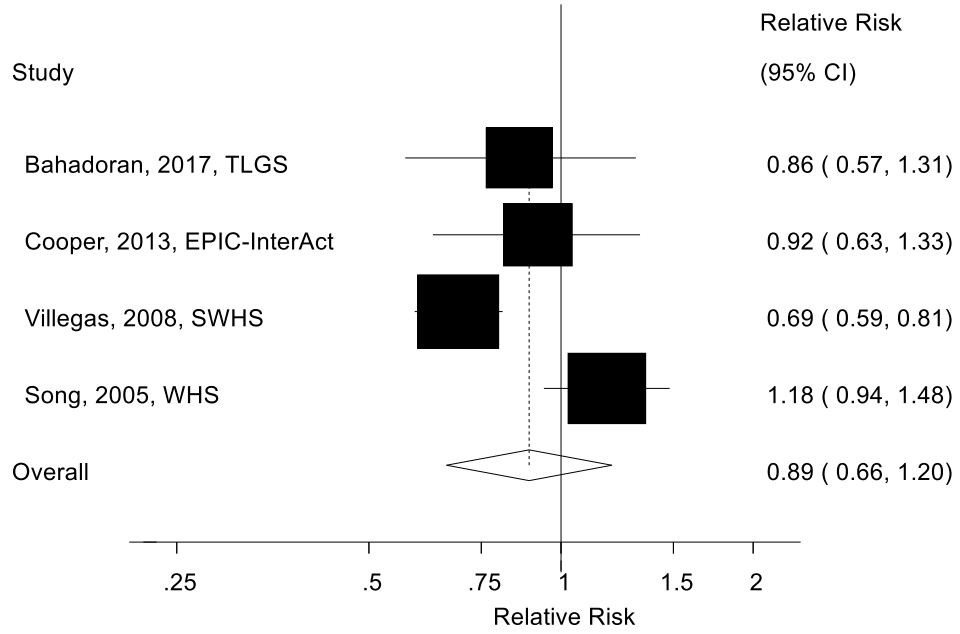


Supplemental Figure 51. Watermelon and type 2 diabetes, nonlinear dose-response analysis

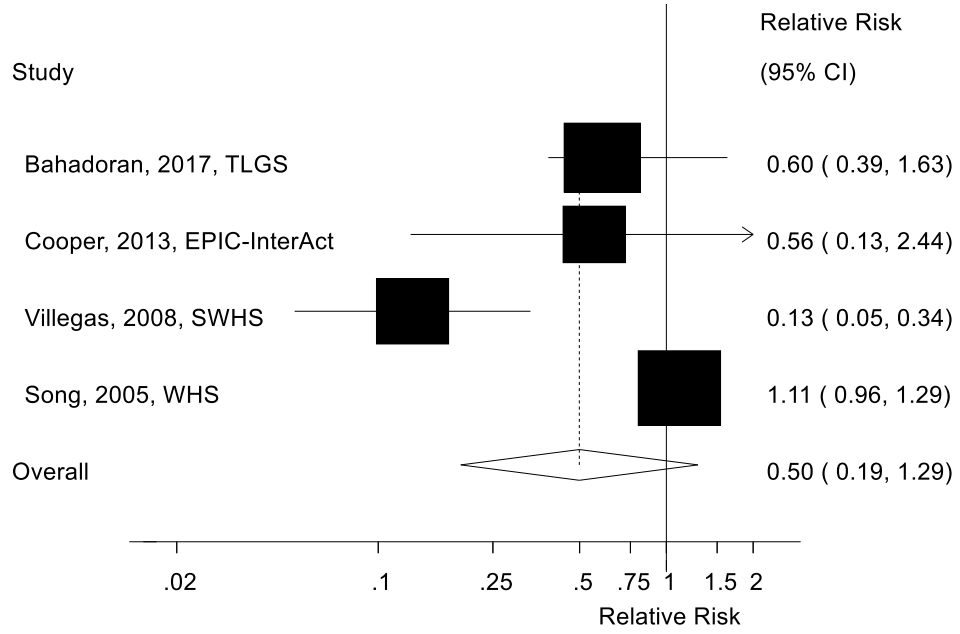


Supplemental Figures of subtypes of vegetables

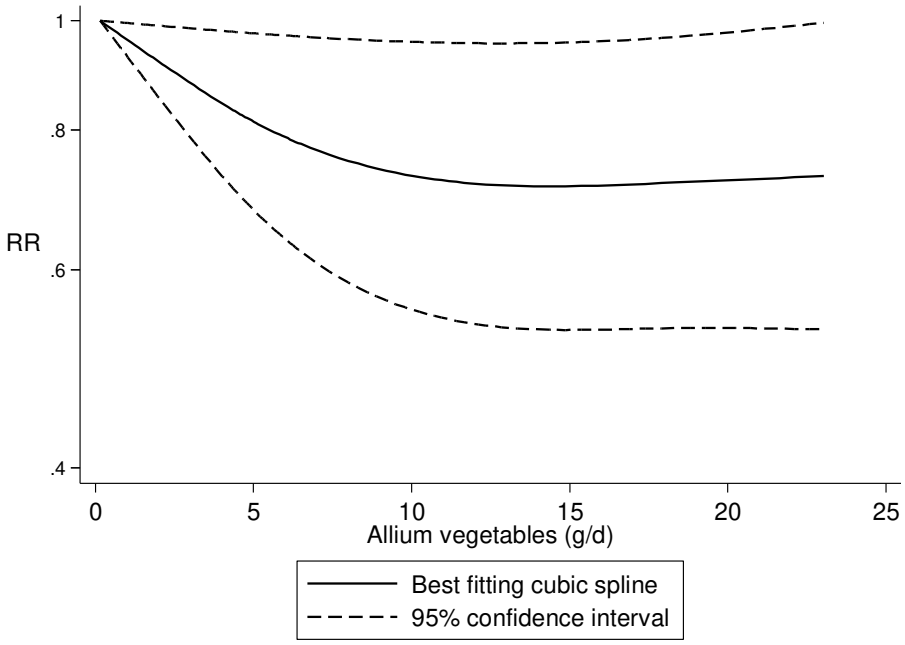
Supplemental Figure 52. Allium vegetables and type 2 diabetes, high vs. low



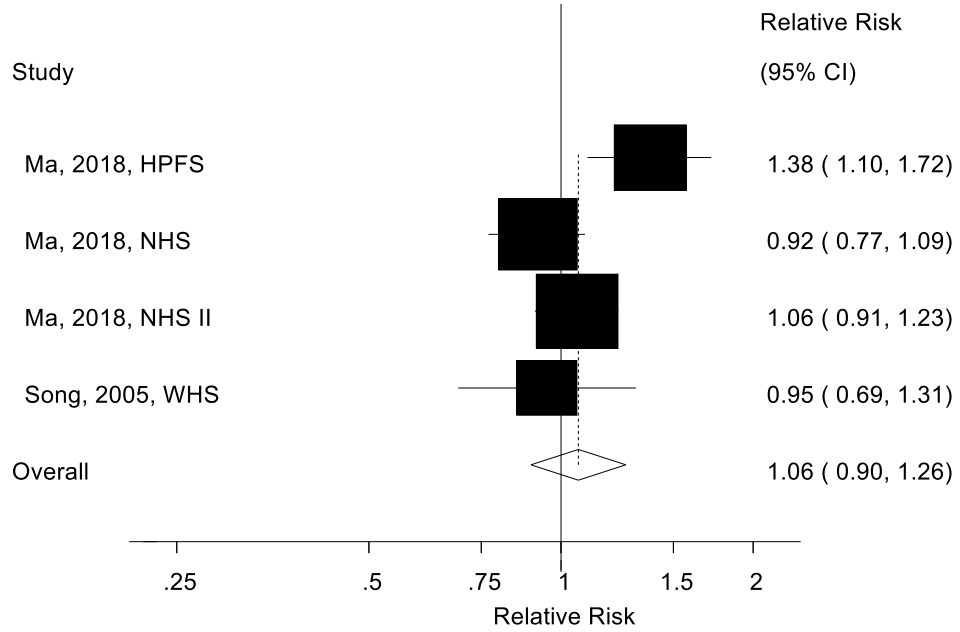
Supplemental Figure 53. Allium vegetables and type 2 diabetes, dose-response analysis per 100 g/d



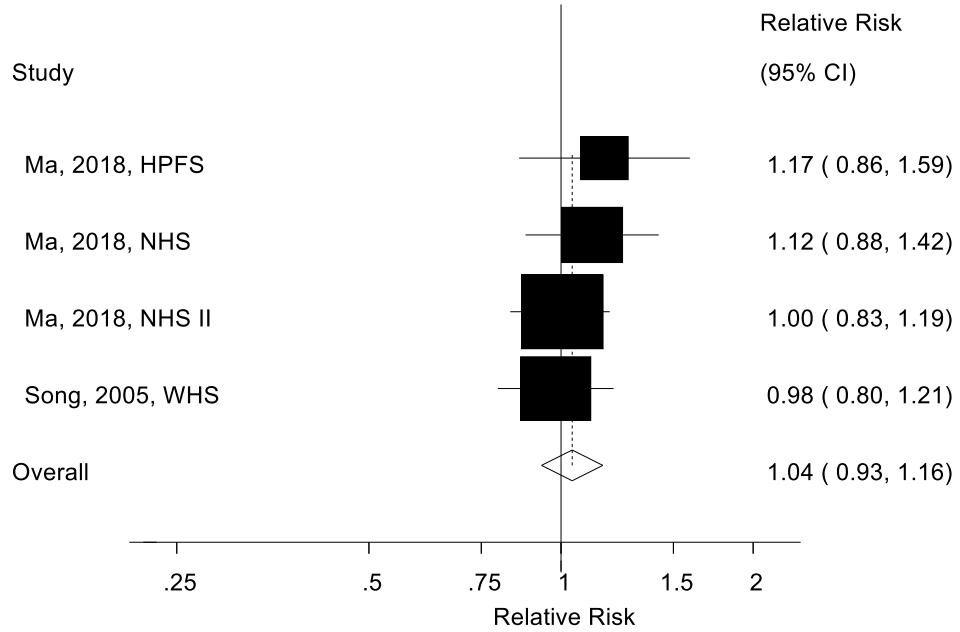
Supplemental Figure 54. Allium vegetables and type 2 diabetes, nonlinear dose-response analysis



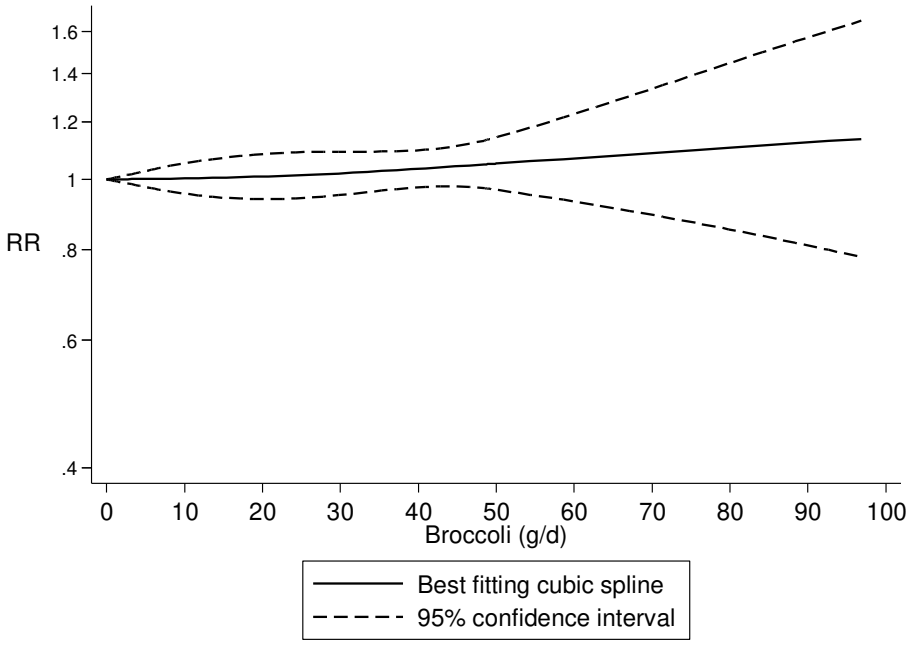
Supplemental Figure 55. Broccoli and type 2 diabetes, high vs. low



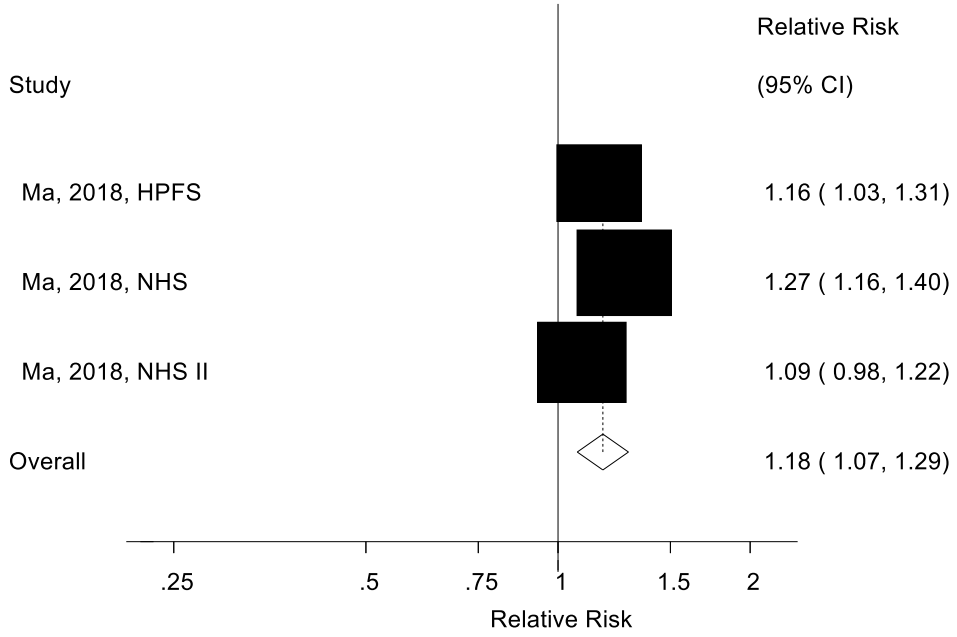
Supplemental Figure 56. Broccoli and type 2 diabetes, dose-response analysis per 100 g/d



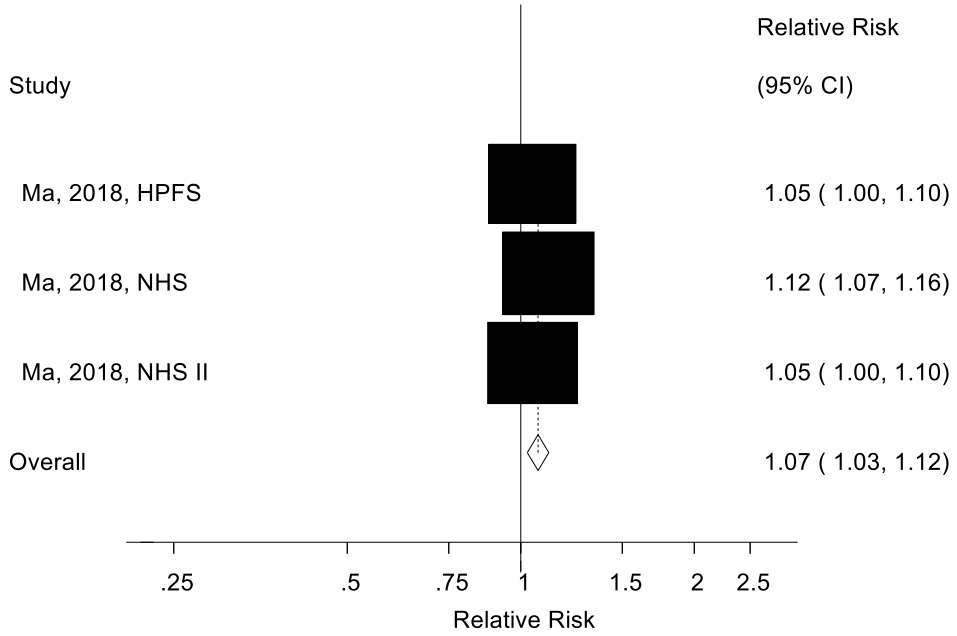
Supplemental Figure 57. Broccoli and type 2 diabetes, nonlinear dose-response analysis



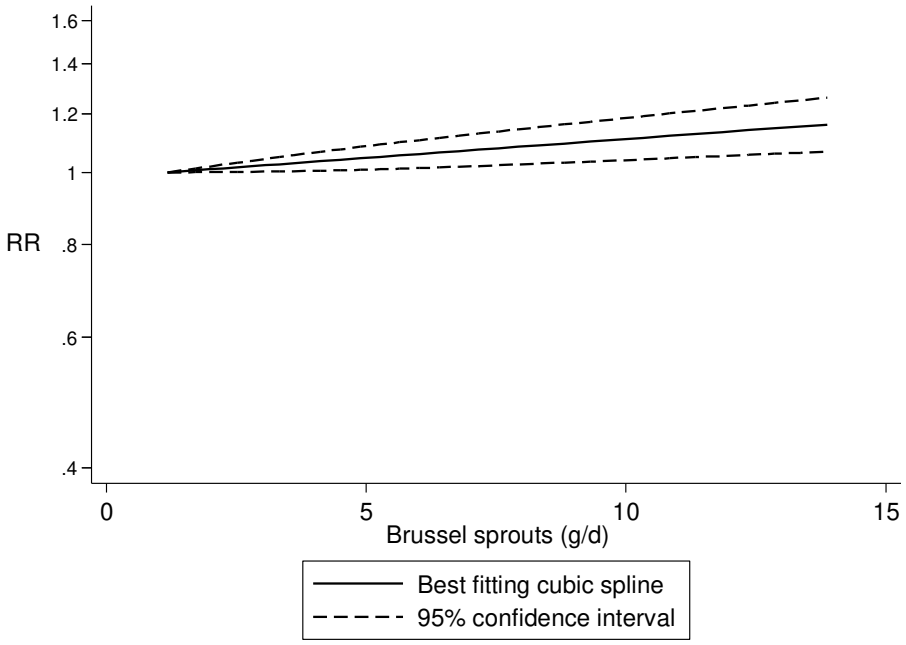
Supplemental Figure 58. Brussels sprouts and type 2 diabetes, high vs. low



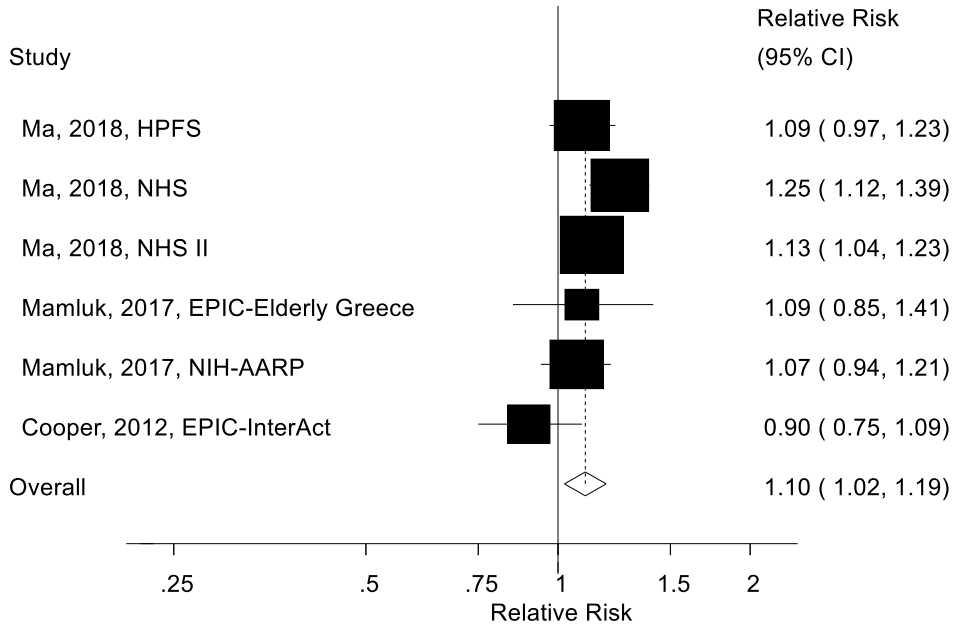
Supplemental Figure 59. Brussels sprouts and type 2 diabetes, dose-response analysis per 10 g/d



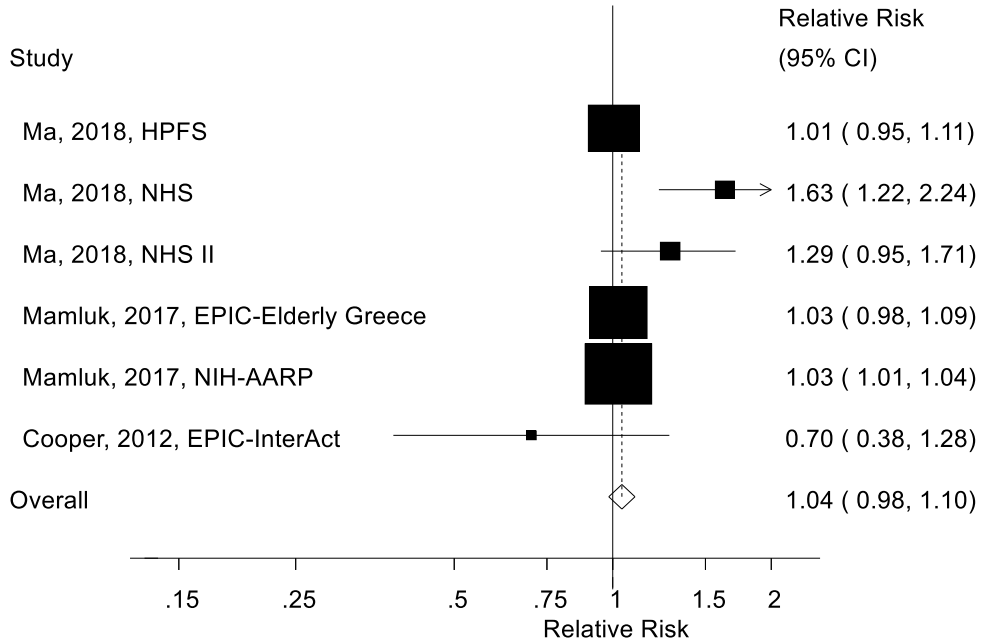
Supplemental Figure 60. Brussels sprouts and type 2 diabetes, nonlinear dose-response analysis



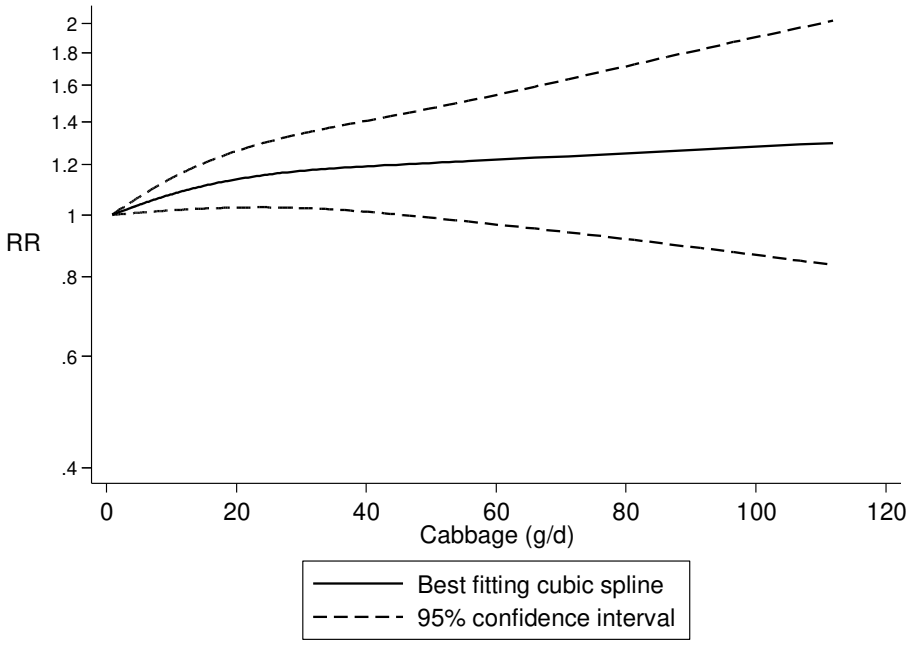
Supplemental Figure 61. Cabbage and type 2 diabetes, high vs. low



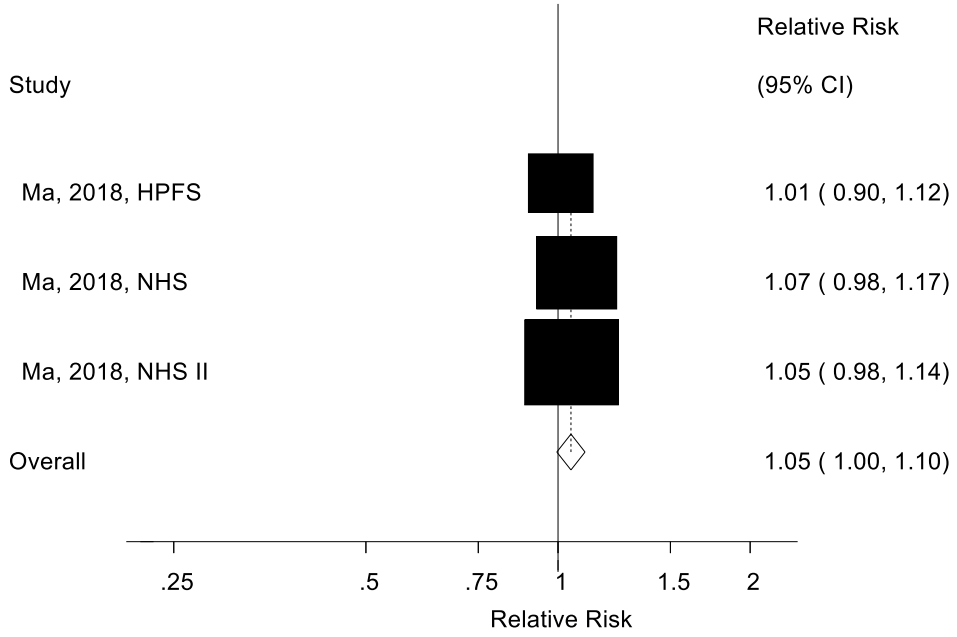
Supplemental Figure 62. Cabbage and type 2 diabetes, dose-response analysis per 100 g/d



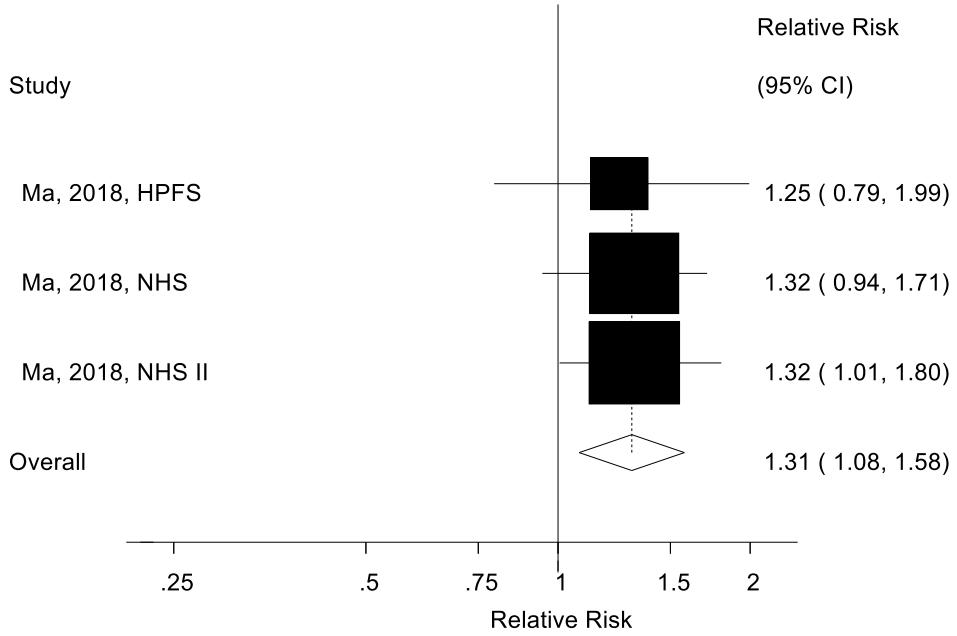
Supplemental Figure 63. Cabbage and type 2 diabetes, nonlinear dose-response analysis



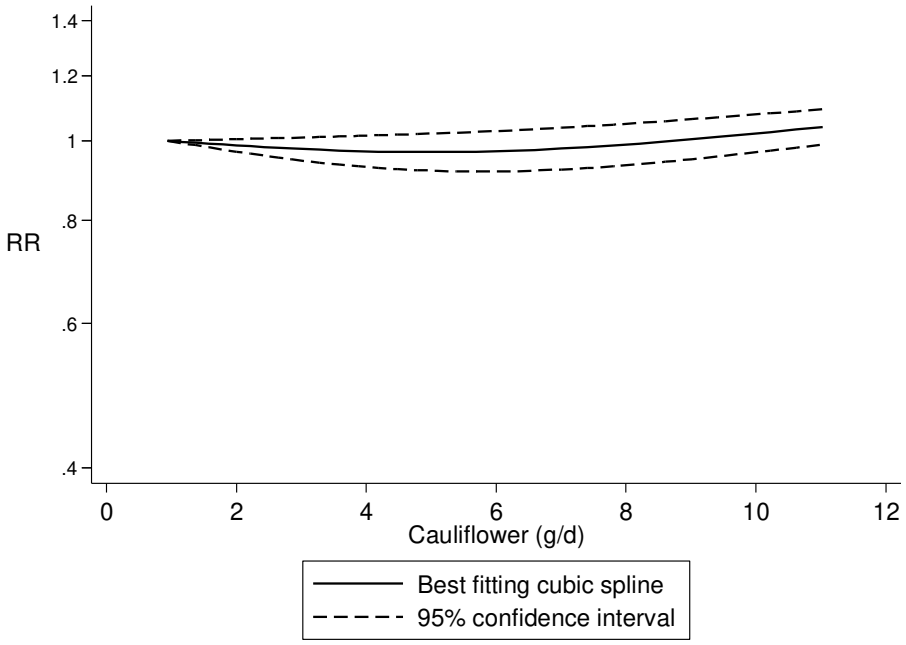
Supplemental Figure 64. Cauliflower and type 2 diabetes, high vs. low



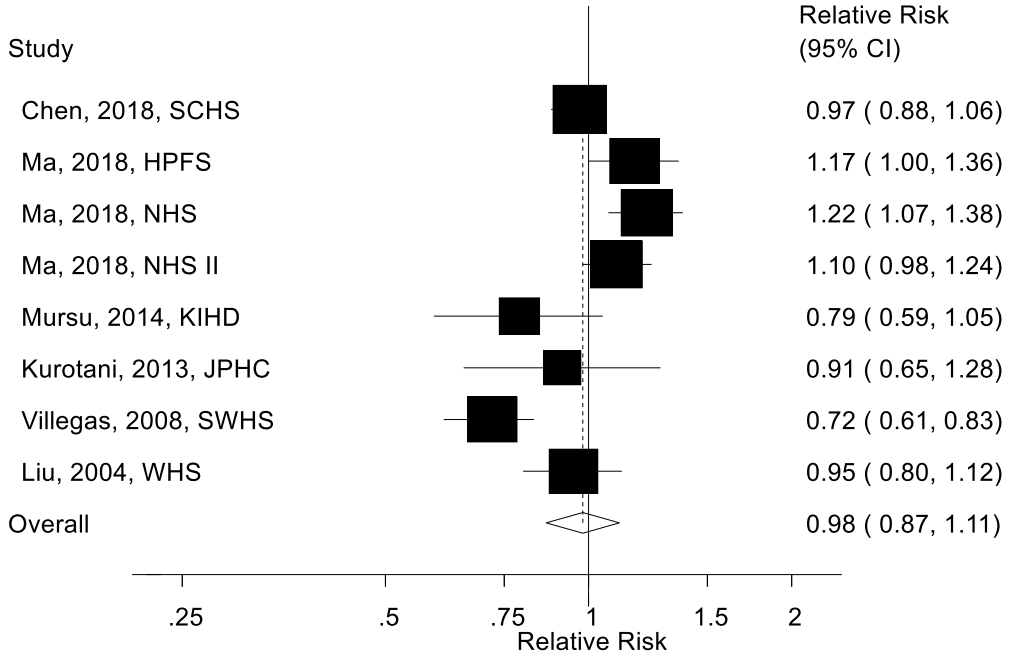
Supplemental Figure 65. Cauliflower and type 2 diabetes, dose-response analysis per 100 g/d



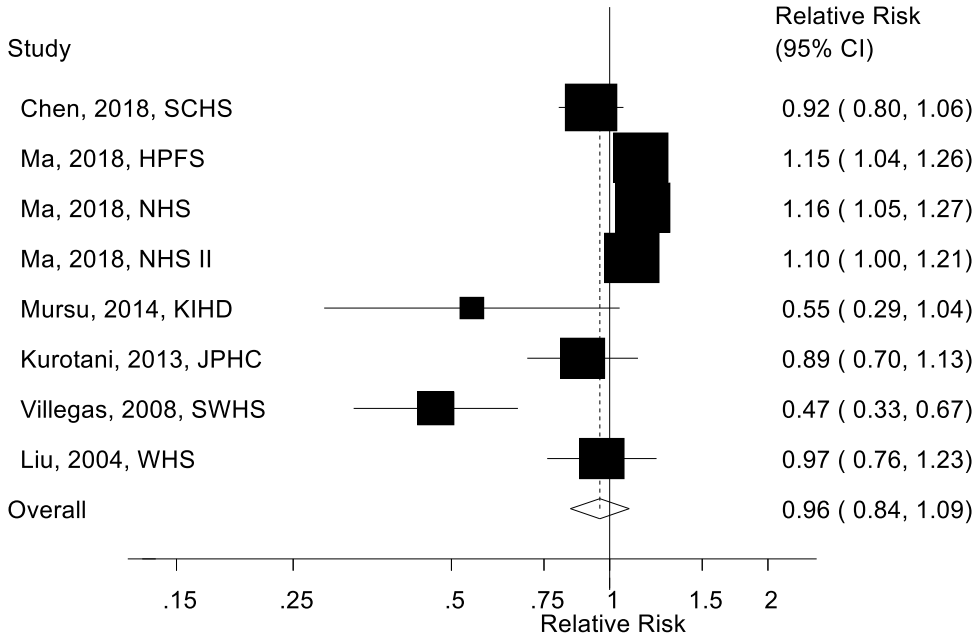
Supplemental Figure 66. Cauliflower and type 2 diabetes, nonlinear dose-response analysis



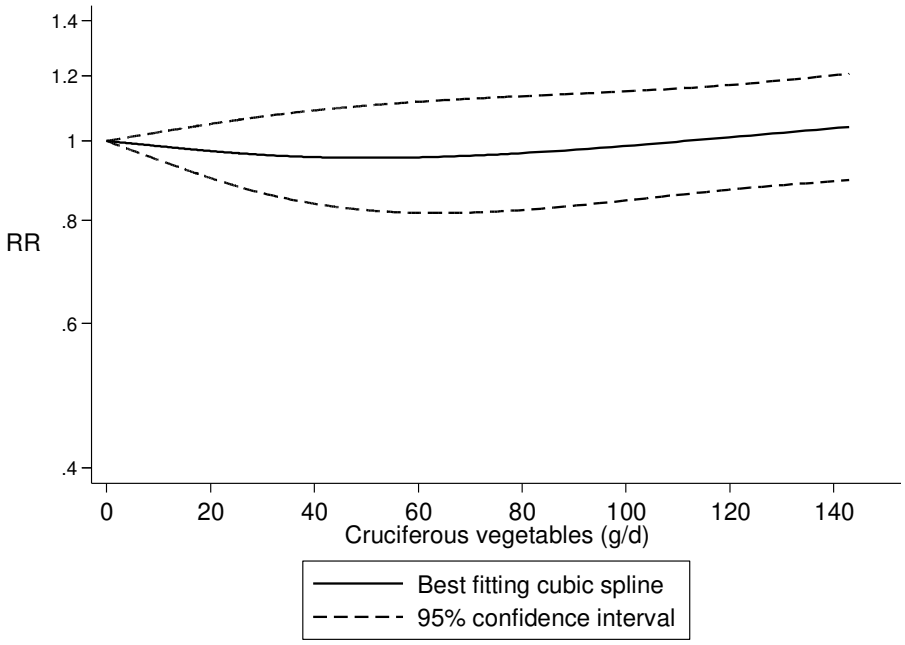
Supplemental Figure 67 . Cruciferous vegetables and type 2 diabetes, high vs. low



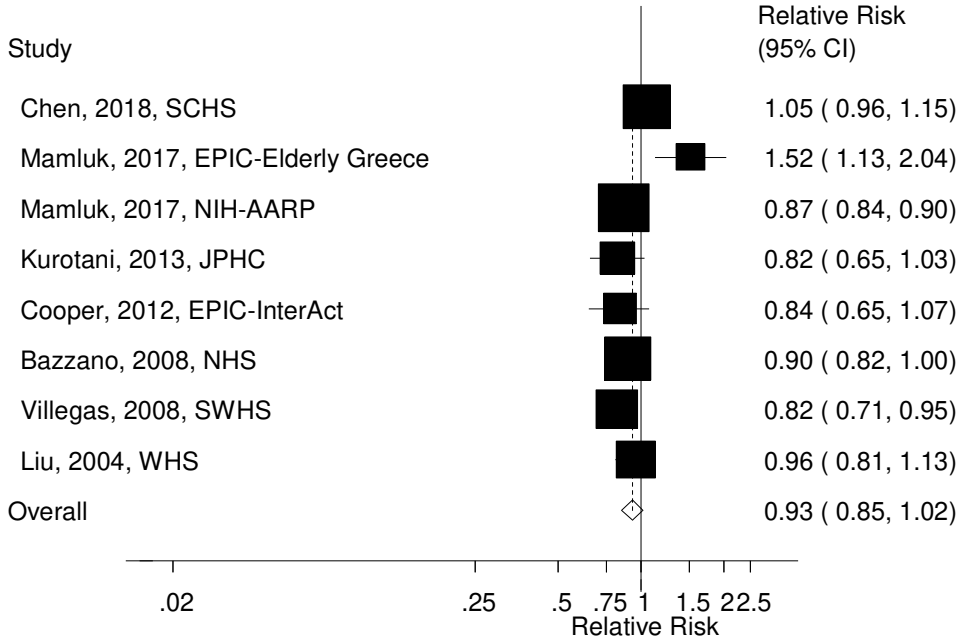
Supplemental Figure 68. Cruciferous vegetables and type 2 diabetes, dose-response analysis per 100 g/d



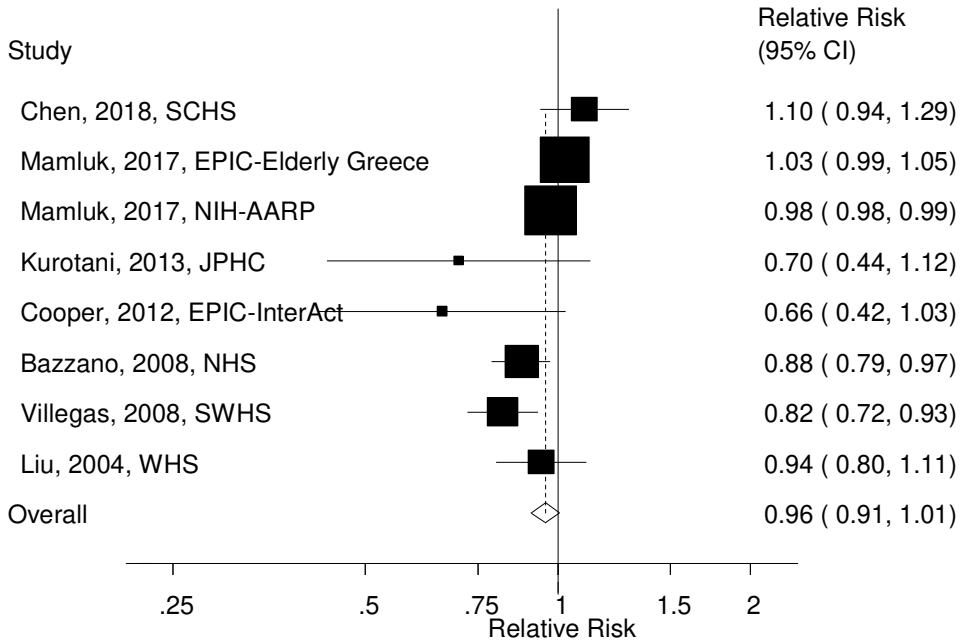
Supplemental Figure 69. Cruciferous vegetables and type 2 diabetes, nonlinear dose-response analysis



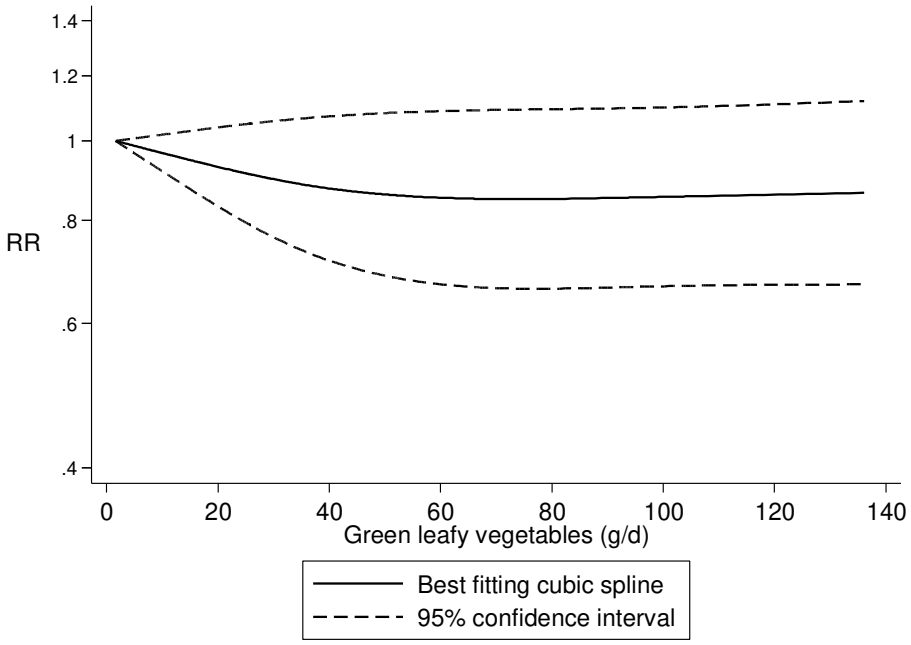
Supplemental Figure 70. Green leafy vegetables and type 2 diabetes, high vs. low



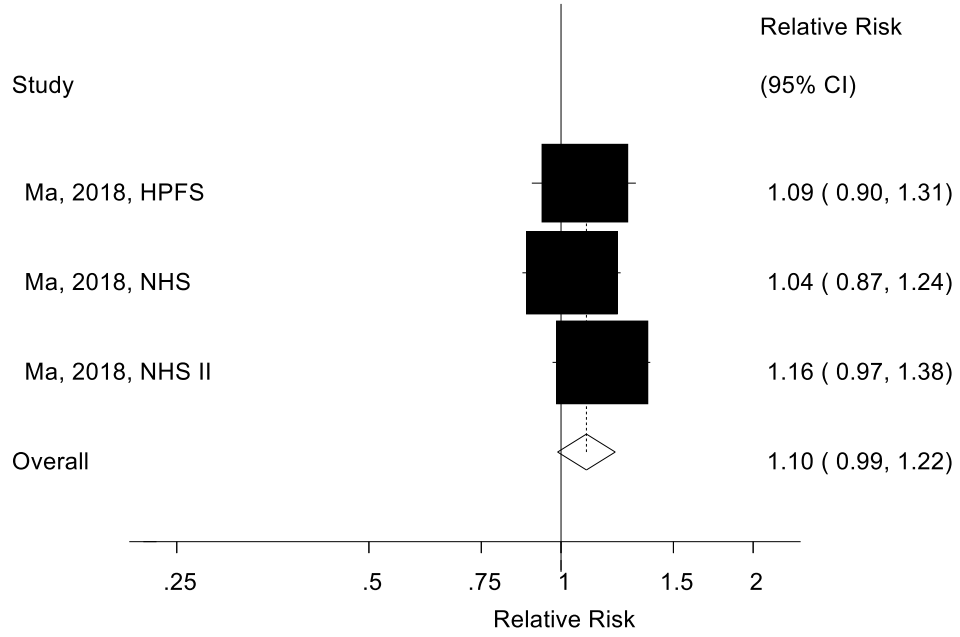
Supplemental Figure 71. Green leafy vegetables and type 2 diabetes, dose-response analysis per 100 g/d



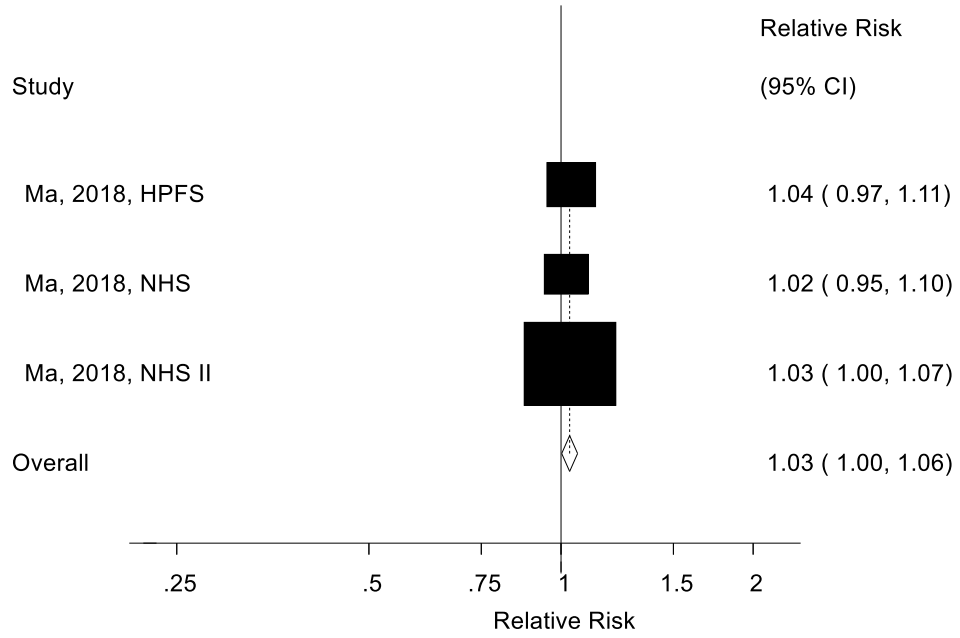
Supplemental Figure 72. Green leafy vegetables and type 2 diabetes, nonlinear dose-response analysis



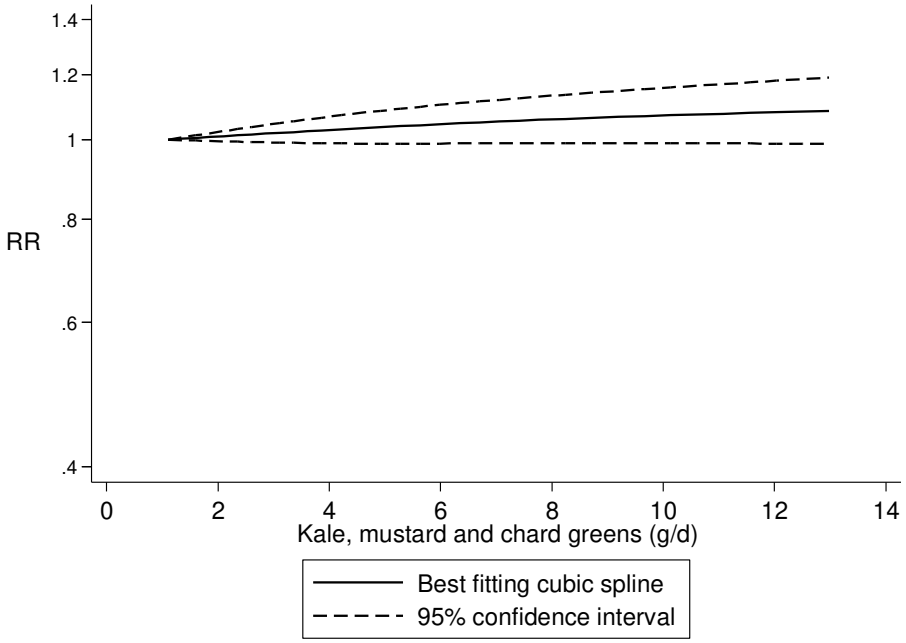
Supplemental Figure 73. Kale, mustard and chard greens and type 2 diabetes, high vs. low



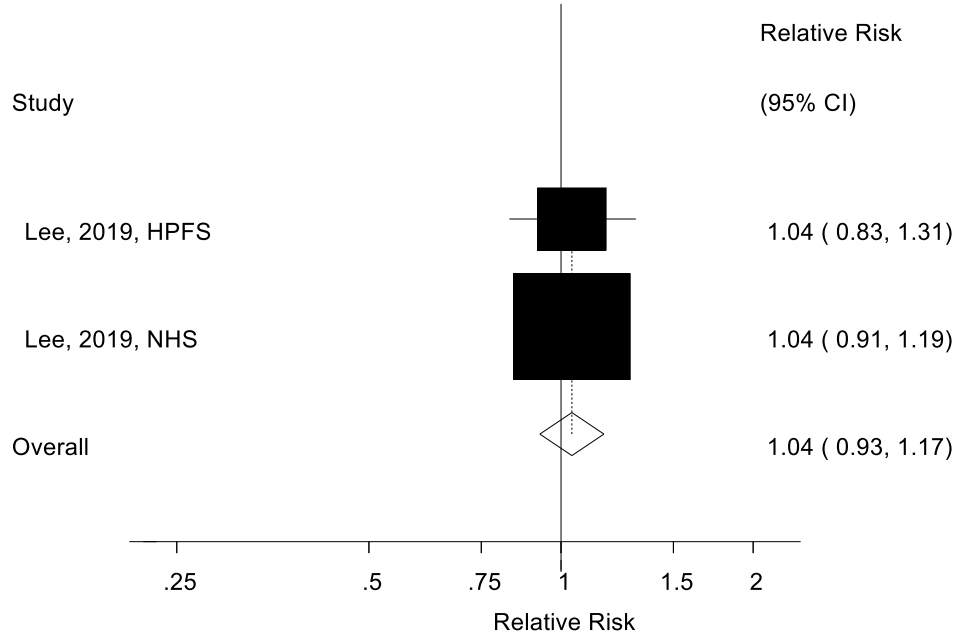
Supplemental Figure 74. Kale, mustard and chard greens and type 2 diabetes, dose-response analysis per 10 g/d



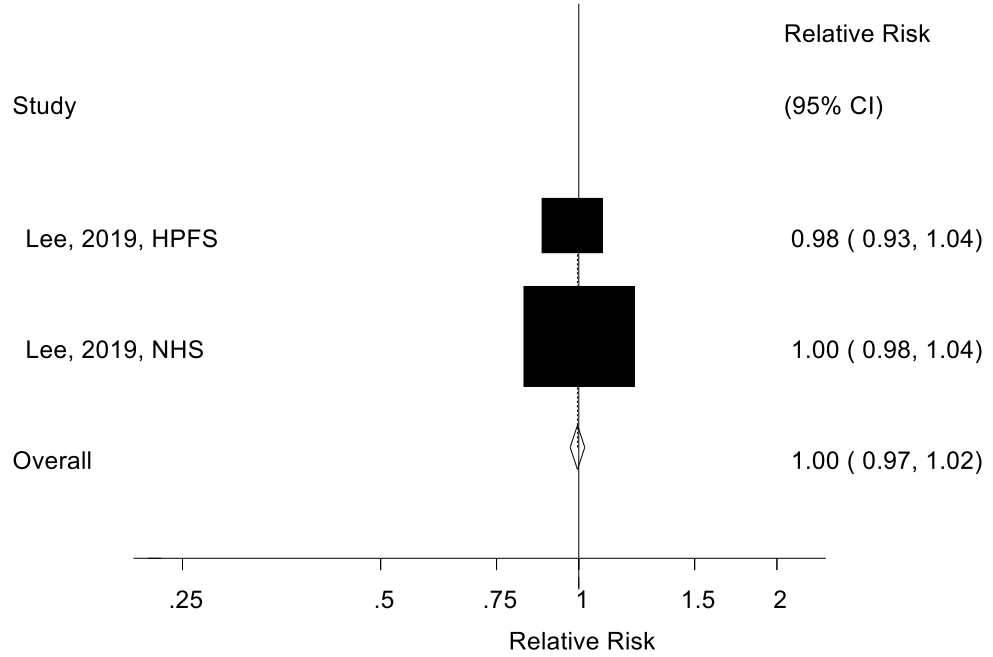
Supplemental Figure 75. Kale, mustard and chard greens and type 2 diabetes, nonlinear dose-response analysis



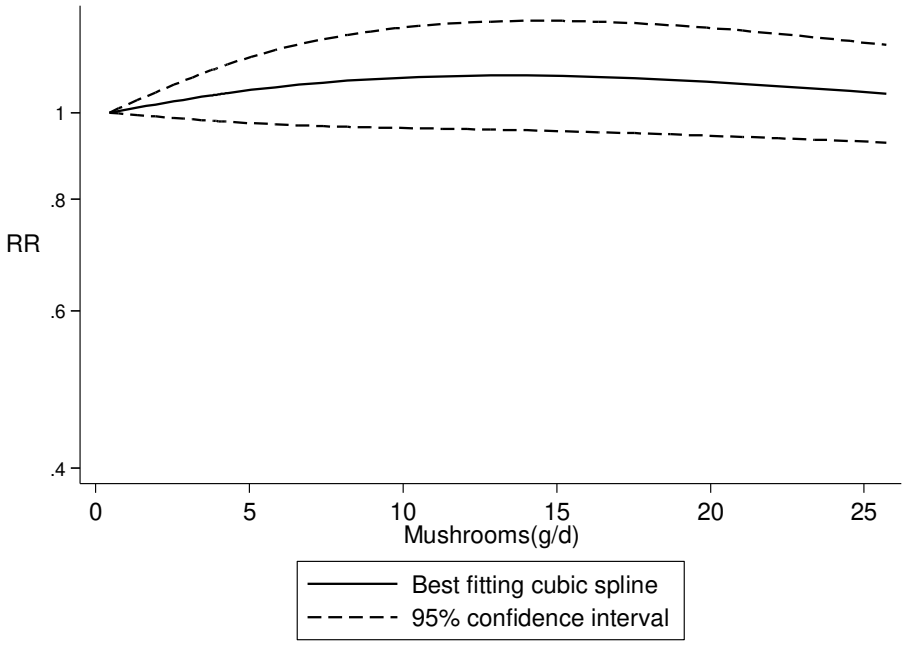
Supplemental Figure 76. Mushrooms and type 2 diabetes, high vs. low



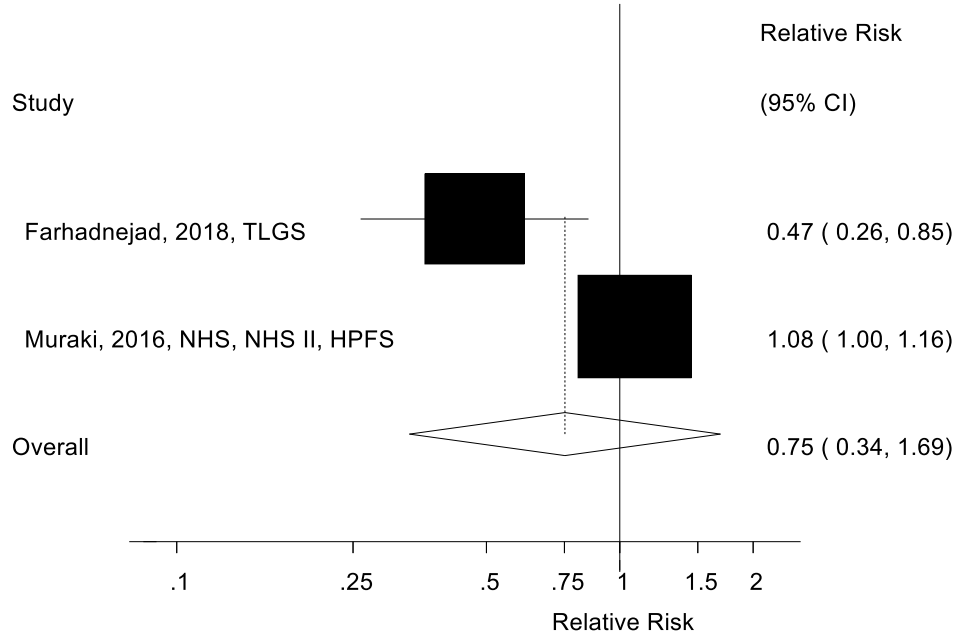
Supplemental Figure 77. Mushrooms and type 2 diabetes, dose-response analysis per 10 g/d



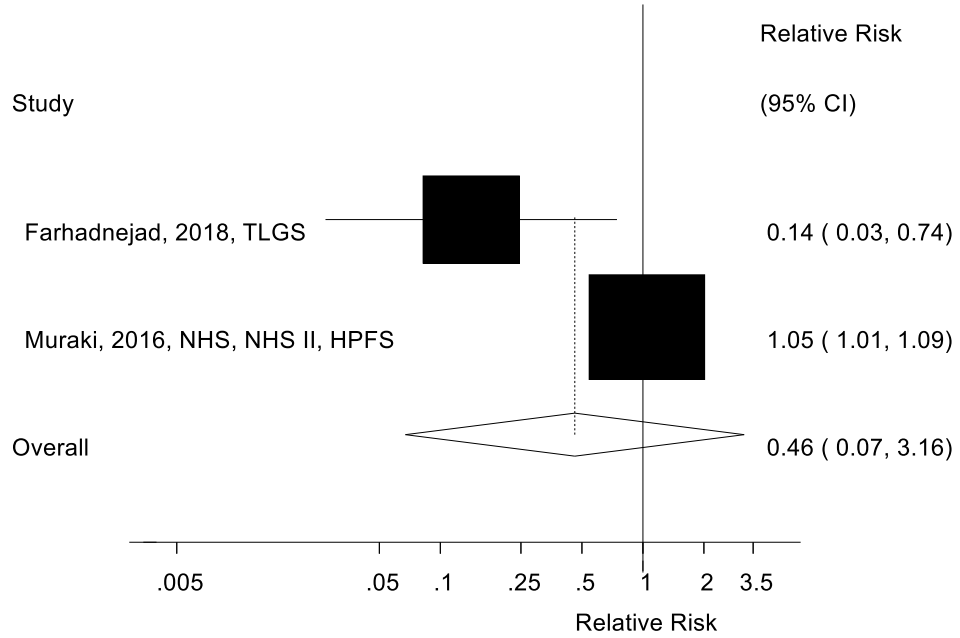
Supplemental Figure 78. Mushrooms and type 2 diabetes, nonlinear dose-response analysis



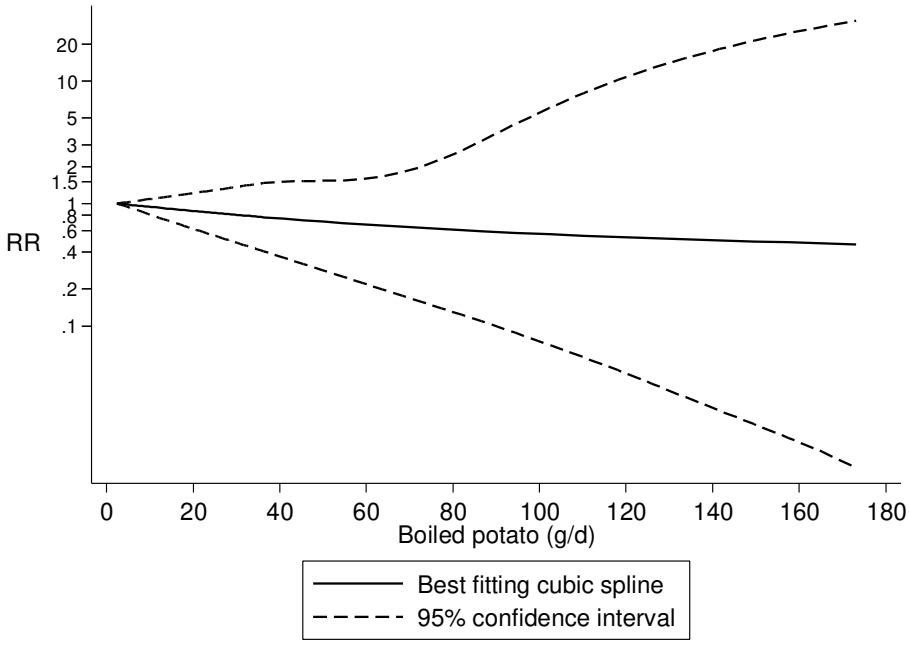
Supplemental Figure 79. Potatoes, boiled and type 2 diabetes, high vs. low



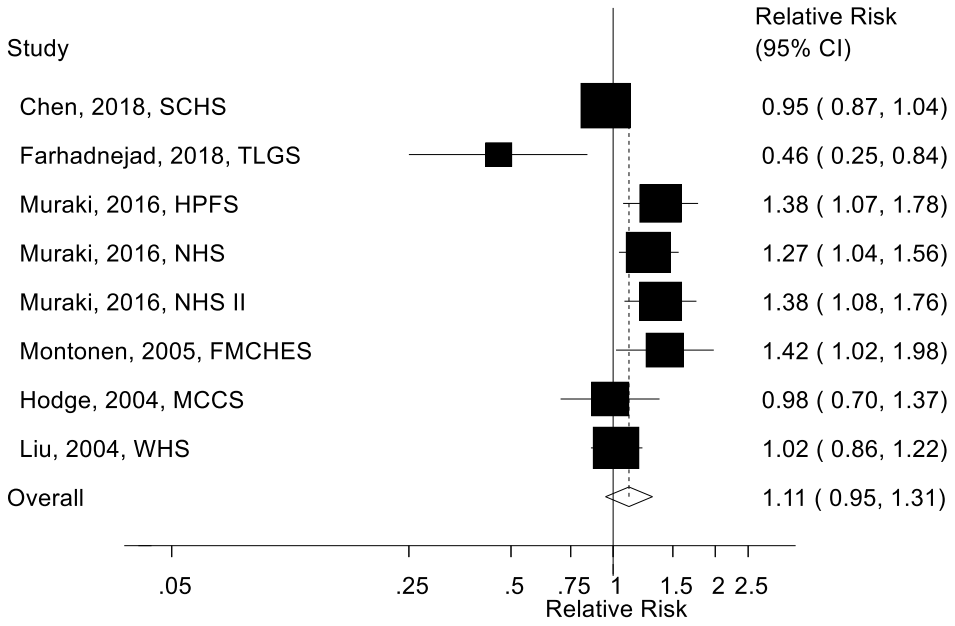
Supplemental Figure 80. Potatoes, boiled and type 2 diabetes, dose-response analysis per 100 g/d



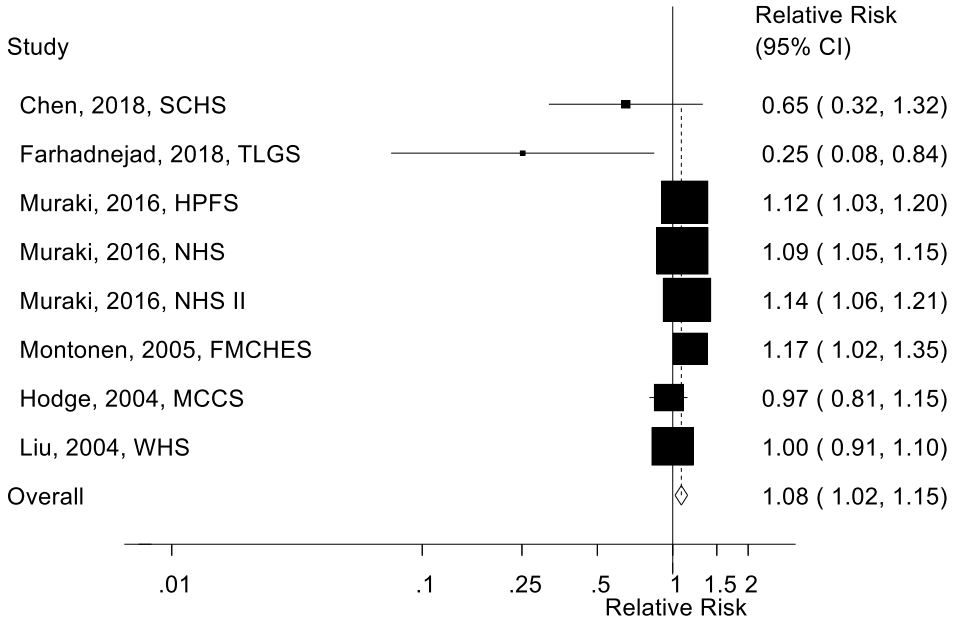
Supplemental Figure 81. Potatoes, boiled and type 2 diabetes, nonlinear dose-response analysis



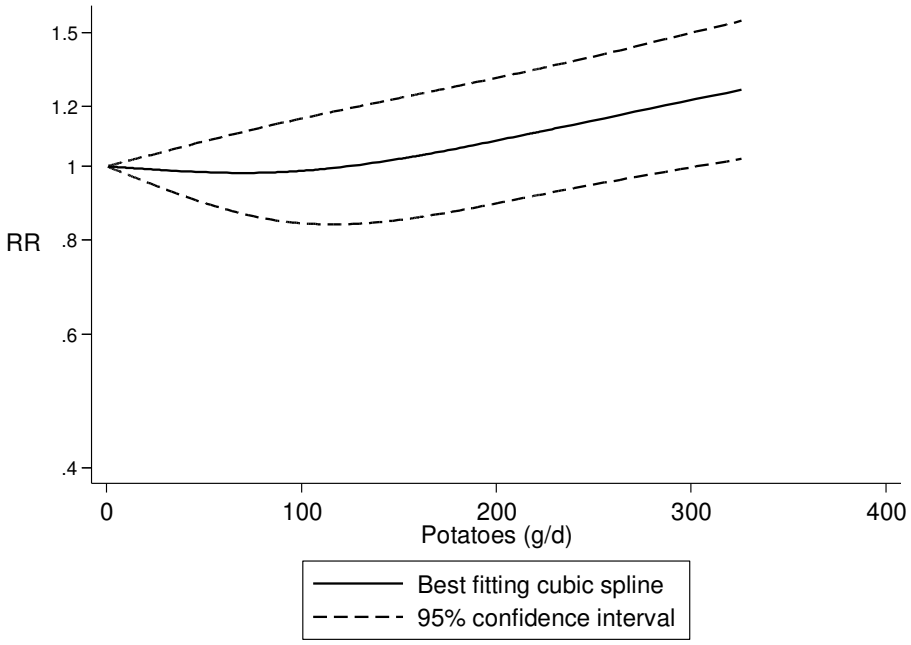
Supplemental Figure 82. Potatoes, total and type 2 diabetes, high vs. low



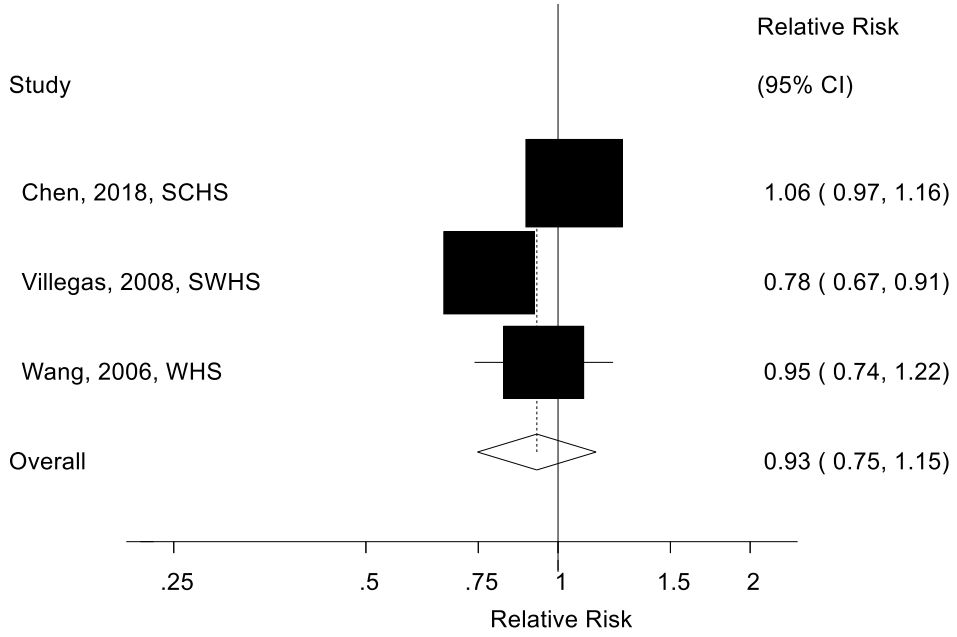
Supplemental Figure 83. Potatoes, total and type 2 diabetes, dose-response analysis per 100 g/d



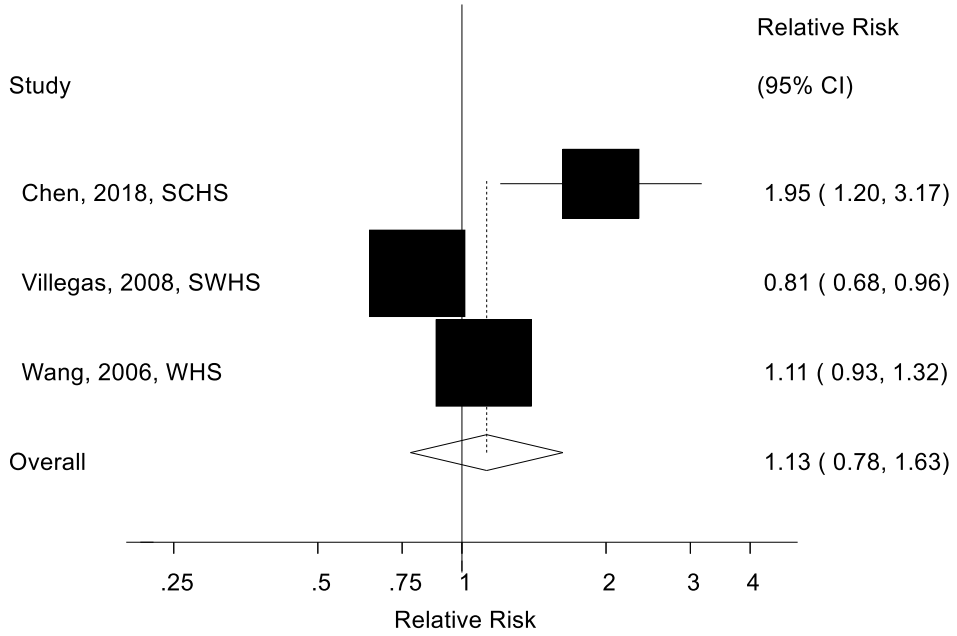
Supplemental Figure 84. Potatoes, total and type 2 diabetes, nonlinear dose-response analysis



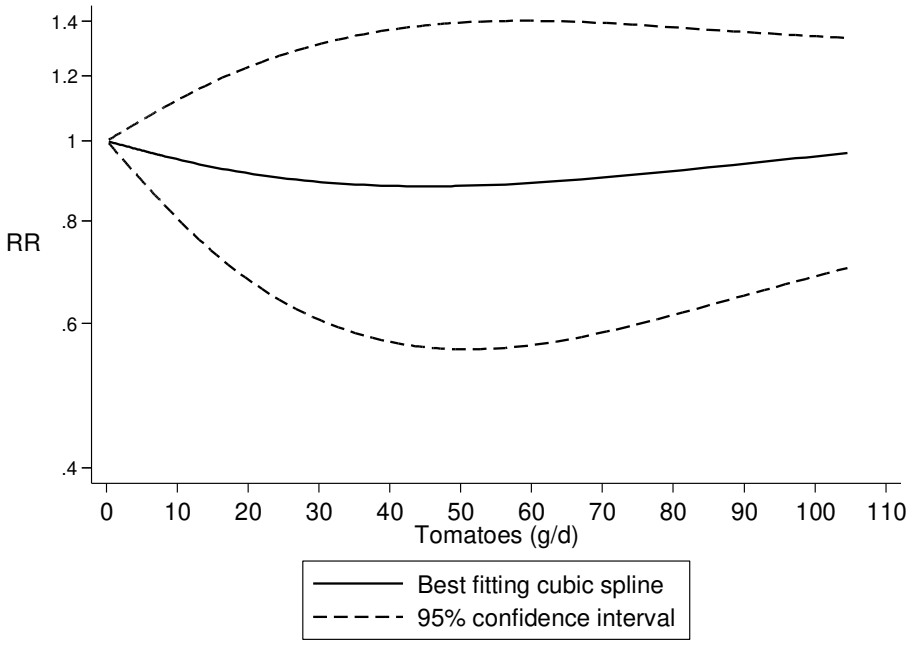
Supplemental Figure 85. Tomatoes and type 2 diabetes, high vs. low



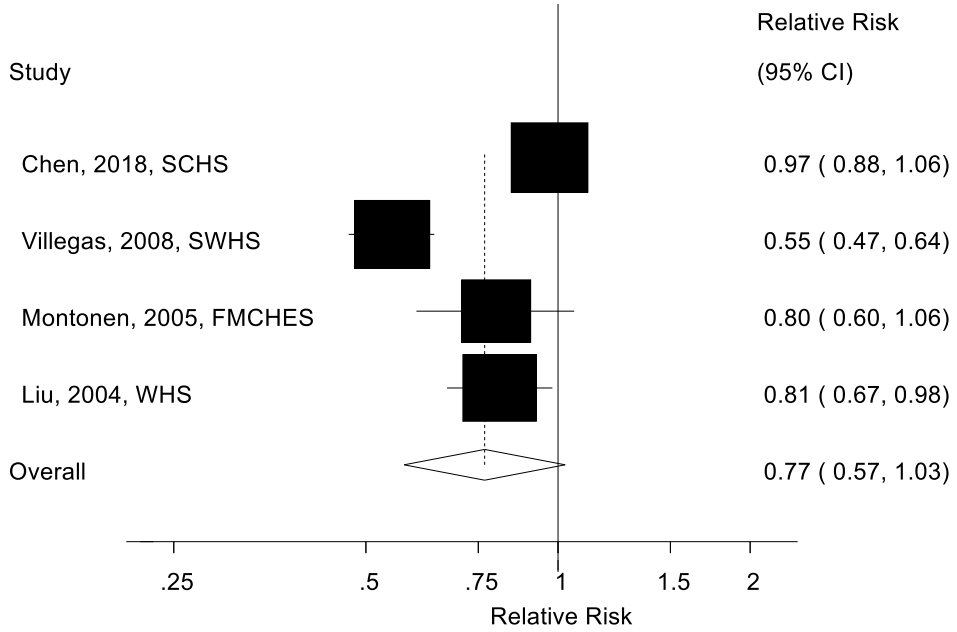
Supplemental Figure 86. Tomatoes and type 2 diabetes, dose-response analysis per 100 g/d



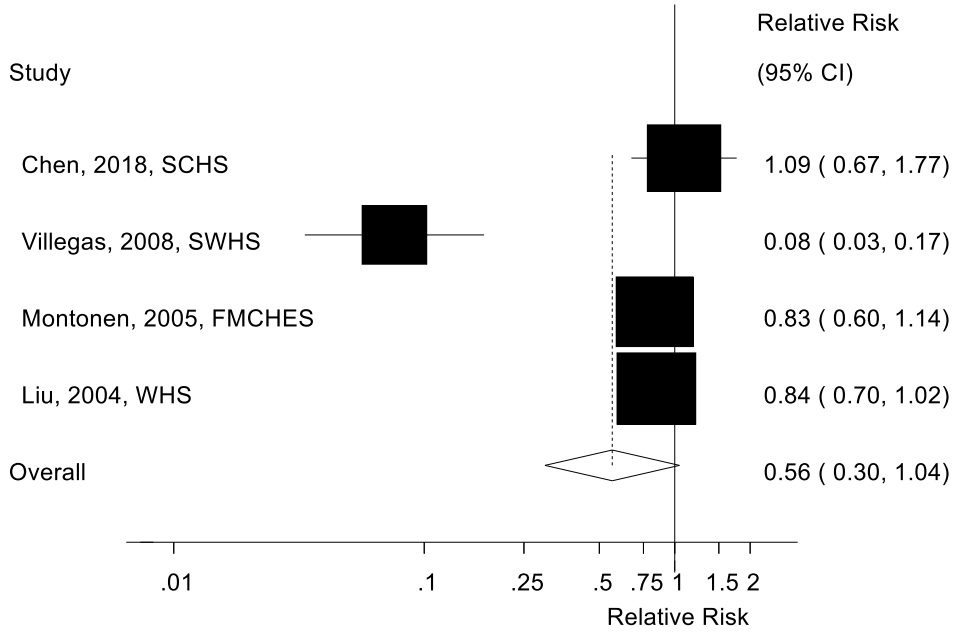
Supplemental Figure 87. Tomatoes and type 2 diabetes, nonlinear dose-response analysis



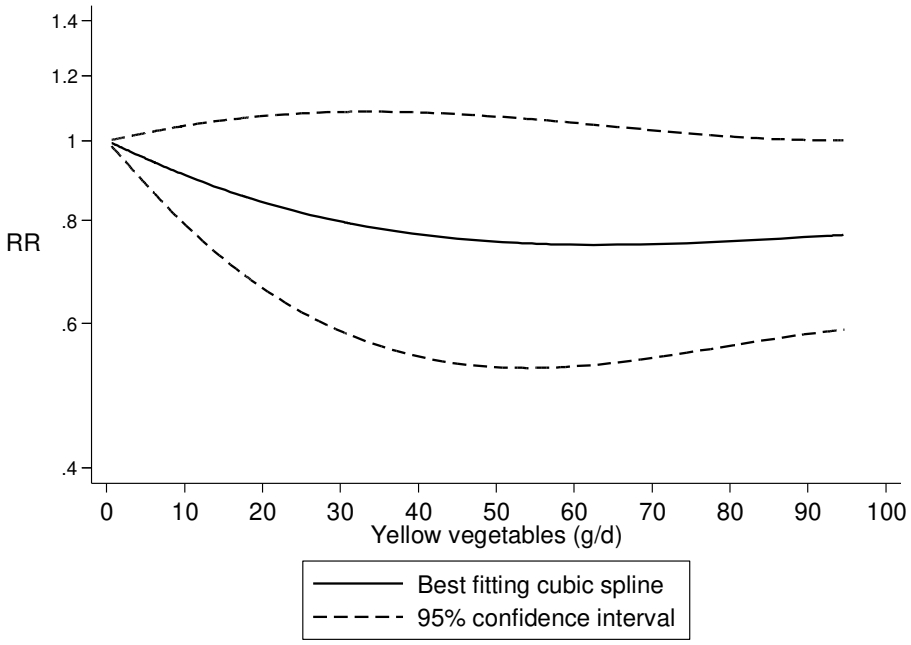
Supplemental Figure 88. Yellow vegetables and type 2 diabetes, high vs. low



Supplemental Figure 89. Yellow vegetables and type 2 diabetes, dose-response analysis per 100 g/d

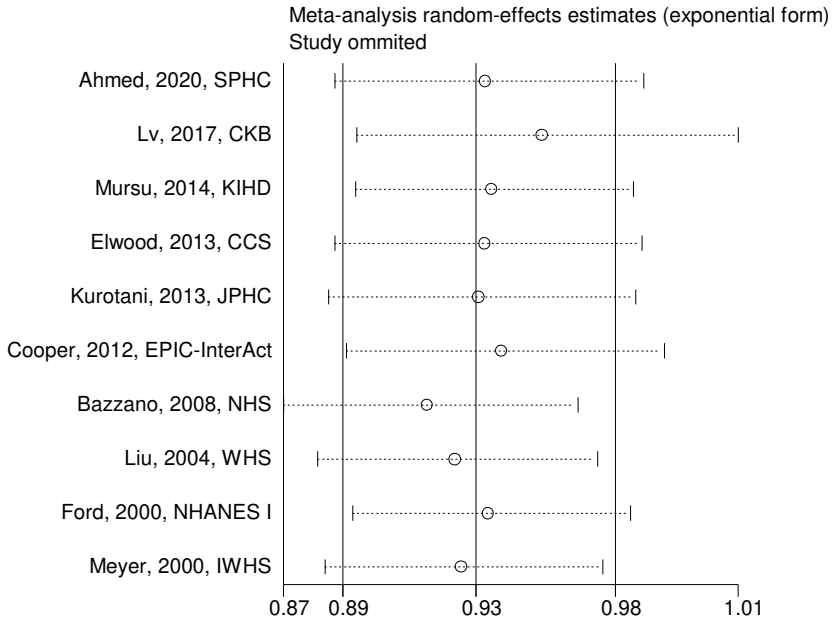


Supplemental Figure 90. Yellow vegetables and type 2 diabetes, nonlinear dose-response analysis



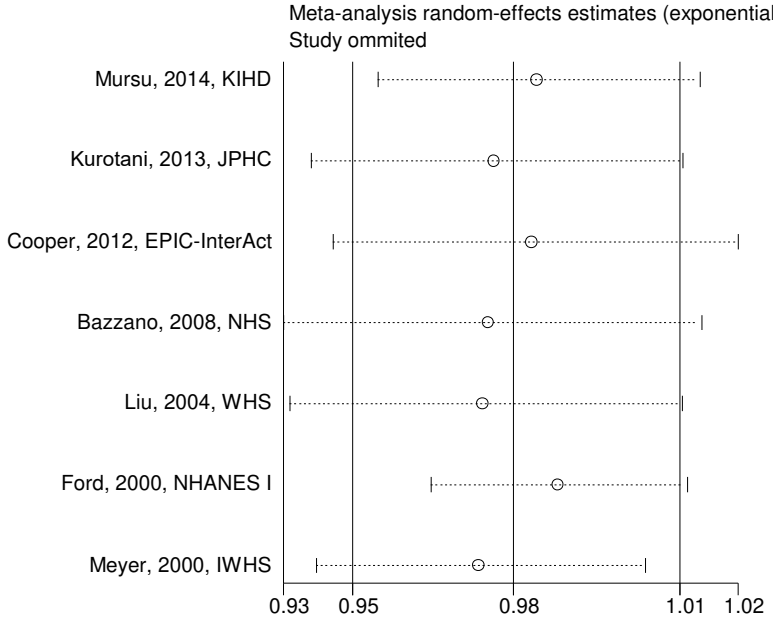
Influence analyses

Supplemental Figure 91. Influence analysis of fruit and vegetables and type 2 diabetes, high vs. low



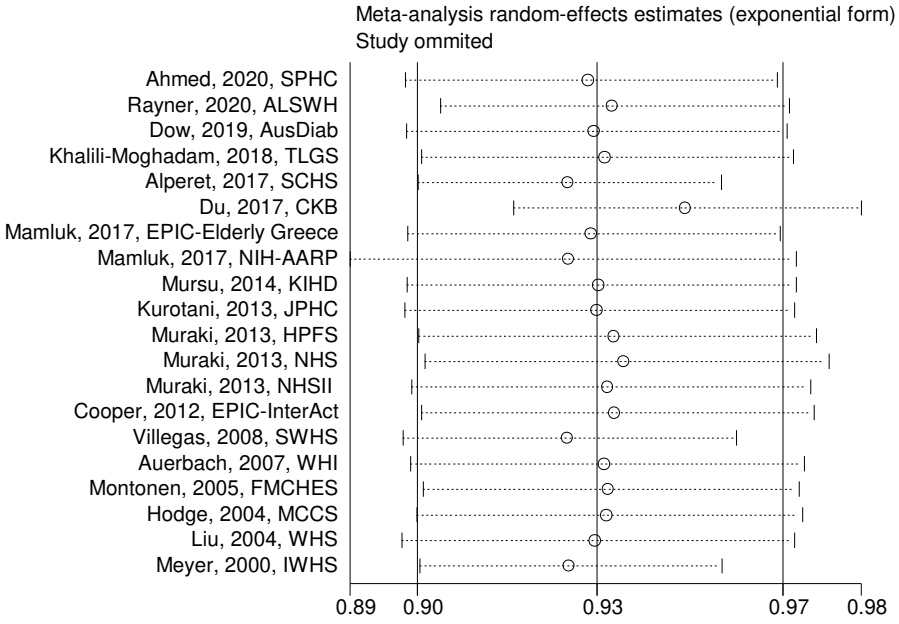
Study omitted	e^coef.	[95% Conf.	Interval]
Ahmed, 2020, SPHC	0.93547297	0.88919145	0.98416334
Lv, 2017, CKB	0.95280933	0.89588749	1.0133477
Mursu, 2014, KIHD	0.93734324	0.89556736	0.9810679
Elwood, 2013, CCS	0.93528491	0.88917738	0.9837833
Kurotani, 2013, JPHC	0.9332673	0.88722008	0.98170435
Cooper, 2012, EPIC-InterAct	0.94038975	0.89269066	0.99063748
Bazzano, 2008, NHS	0.91757935	0.87332505	0.96407616
Liu, 2004, WHS	0.92597556	0.88390166	0.97005224
Ford, 2000, NHANES I	0.93639976	0.89467269	0.98007292
Meyer, 2000, IWHS	0.92791849	0.88620329	0.97159731
Combined	0.93264382	0.89156727	0.97561285

Supplemental Figure 92. Influence analysis of fruit and vegetables and type 2 diabetes, dose-response



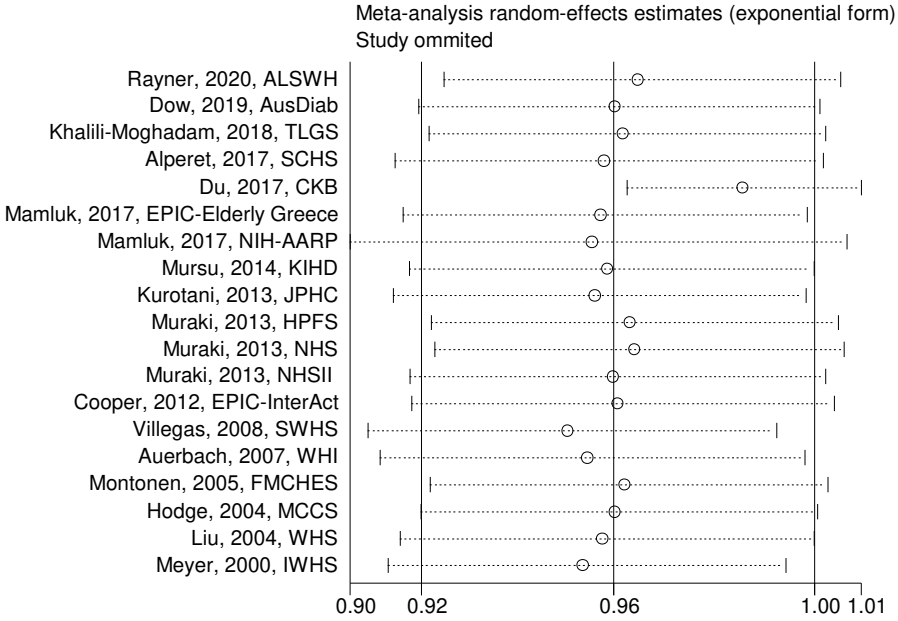
Study omitted	e^coef.	[95% Conf.	Interval]
Mursu, 2014, KIHD	0.98320258	0.95193875	1.0154932
Kurotani, 2013, JPHC	0.97476596	0.93873465	1.0121802
Cooper, 2012, EPIC-InterAct	0.98224336	0.94305086	1.0230646
Bazzano, 2008, NHS	0.97366518	0.93324012	1.0158414
Liu, 2004, WHS	0.97250021	0.93453473	1.0120081
Ford, 2000, NHANES I	0.98739189	0.96240878	1.0130235
Meyer, 2000, IWHS	0.97170234	0.93973494	1.0047572
Combined	0.97869077	0.94691062	1.0115375

Supplemental Figure 93. Influence analysis of fruits and type 2 diabetes, high vs. low



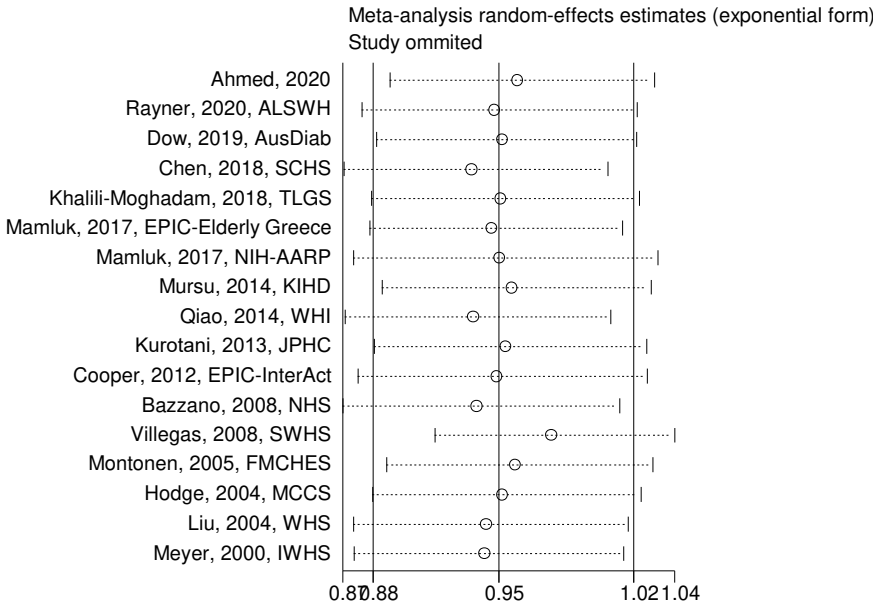
Study omitted	e^coef.	[95% Conf.	Interval]
Ahmed, 2020, SPHC	0.93247199	0.90179646	0.96419102
Rayner, 2020, ALSWH	0.93652213	0.90771925	0.96623892
Dow, 2019, AusDiab	0.93341899	0.90204149	0.96588802
Khalili-Moghadam, 2018, TLGS	0.93519598	0.90447289	0.96696264
Alperet, 2017, SCHS	0.92904216	0.9039278	0.95485425
Du, 2017, CKB	0.94871879	0.92000133	0.97833264
Mamluk, 2017, EPIC-Elderly Greece	0.93295616	0.90221488	0.96474493
Mamluk, 2017, NIH-AARP	0.92918587	0.89250141	0.9673782
Mursu, 2014, KIHD	0.93418825	0.90211201	0.96740496
Kurotani, 2013, JPHC	0.93386483	0.90173644	0.96713799
Muraki, 2013, HPFS	0.93681407	0.90406692	0.97074729
Muraki, 2013, NHS	0.93841732	0.90511608	0.97294372
Muraki, 2013, NHSII	0.93573397	0.90286249	0.9698022
Cooper, 2012, EPIC-InterAct	0.93684429	0.90447021	0.97037715
Villegas, 2008, SWHS	0.9289788	0.90143943	0.95735955
Auerbach, 2007, WHI	0.93513381	0.90271389	0.96871799
Montonen, 2005, FMCHES	0.93581933	0.90482312	0.96787727
Hodge, 2004, MCCS	0.93554235	0.90377825	0.96842283
Liu, 2004, WHS	0.9335776	0.90119624	0.96712238
Meyer, 2000, IWHS	0.92928594	0.90426886	0.9549951
Combined	0.93400961	0.90386586	0.96515866

Supplemental Figure 94. Influence analysis of fruits and type 2 diabetes, dose-response



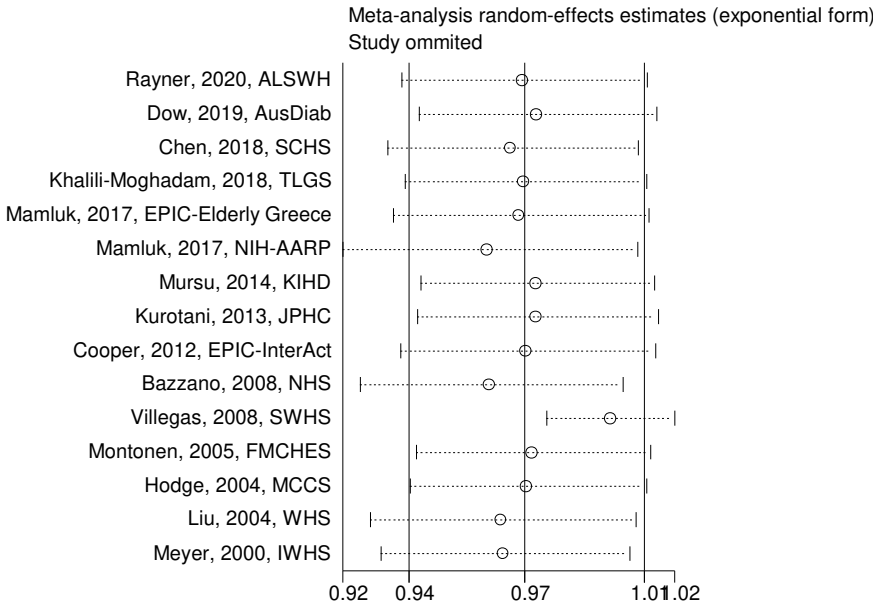
Study omitted	e^coef.	[95% Conf.	Interval]
Rayner, 2020, ALSWH	0.96176034	0.92036897	1.0050132
Dow, 2019, AusDiab	0.95680082	0.91494524	1.0005711
Khalili-Moghadam, 2018, TLGS	0.95852929	0.91716462	1.0017595
Alperet, 2017, SCHS	0.95452982	0.91001111	1.0012265
Du, 2017, CKB	0.98409837	0.95943958	1.009391
Mamluk, 2017, EPIC-Elderly Greece	0.95375156	0.91164643	0.9978013
Mamluk, 2017, NIH-AARP	0.95187545	0.90033776	1.0063633
Mursu, 2014, KIHD	0.95523369	0.91308117	0.99933213
Kurotani, 2013, JPHC	0.95255357	0.90952492	0.99761784
Muraki, 2013, HPFS	0.96008295	0.9176845	1.0044403
Muraki, 2013, NHS	0.96106845	0.91841727	1.0057002
Muraki, 2013, NHSII	0.956442	0.9131425	1.0017947
Cooper, 2012, EPIC-InterAct	0.95750827	0.91350383	1.0036324
Villegas, 2008, SWHS	0.94676578	0.90423012	0.99130237
Auerbach, 2007, WHI	0.95100725	0.90678614	0.99738491
Montonen, 2005, FMCHES	0.95893568	0.91750336	1.002239
Hodge, 2004, MCCS	0.95679522	0.91542429	1.0000358
Liu, 2004, WHS	0.95417082	0.91102695	0.99935794
Meyer, 2000, IWHS	0.94997597	0.90852088	0.99332261
Combined	0.95660443	0.91557687	0.99947047

Supplemental Figure 95. Influence analysis of vegetables and type 2 diabetes, high vs. low



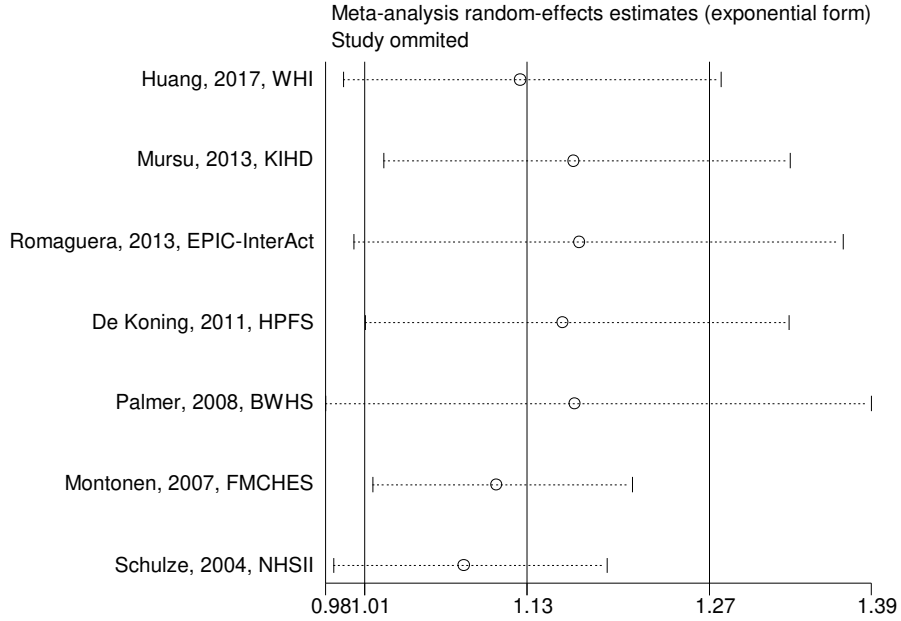
Study omitted	e^coef.	[95% Conf.	Interval]
Ahmed, 2020	.95699638	.8931098	1.025453
Rayner, 2020, ALSWH	.94537294	.87898093	1.0167798
Dow, 2019, AusDiab	.94916427	.88630438	1.0164824
Chen, 2018, SCHS	.93373591	.86996573	1.0021806
Khalili-Moghadam, 2018, TLGS	.94847691	.88392967	1.0177375
Mamluk, 2017, EPIC-Elderly Greece	.94407207	.88301307	1.0093533
Mamluk, 2017, NIH-AARP	.94786	.87478215	1.0270426
Mursu, 2014, KIHD	.95405197	.88918817	1.0236473
Qiao, 2014, WHI	.93470514	.87060452	1.0035254
Kurotani, 2013, JPHC	.95090151	.88521355	1.021464
Cooper, 2012, EPIC-InterAct	.94657701	.87695944	1.0217212
Bazzano, 2008, NHS	.93624836	.8695457	1.0080678
Villegas, 2008, SWHS	.97374165	.91559154	1.0355849
Montonen, 2005, FMCHES	.95577735	.89152259	1.0246632
Hodge, 2004, MCCS	.94916427	.88437188	1.0187036
Liu, 2004, WHS	.9410013	.87486327	1.0121392
Meyer, 2000, IWHS	.9401927	.875144	1.0100765
Combined	.94767391	.88465638	1.0151804

Supplemental Figure 96. Influence analysis of vegetables and type 2 diabetes, dose-response



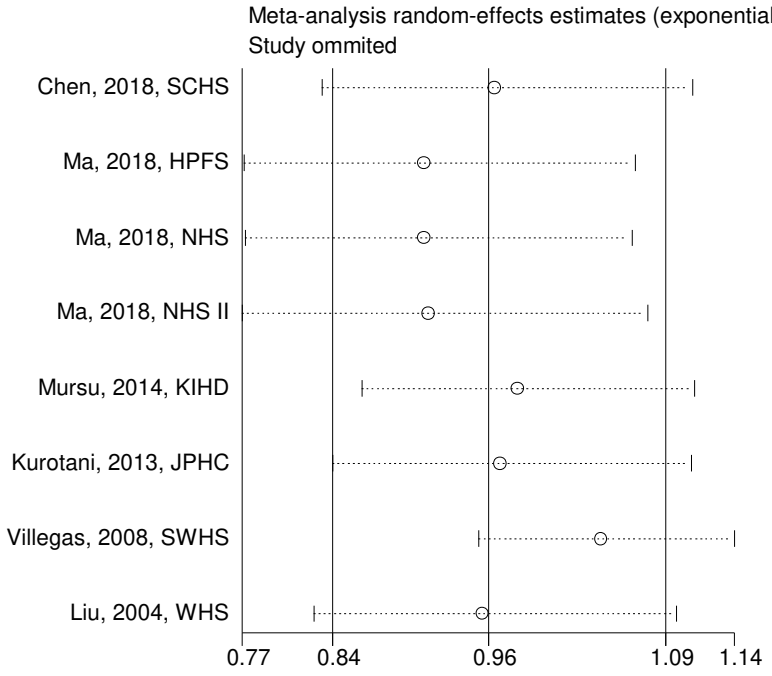
Study omitted	e^coef.	[95% Conf.	Interval]
Rayner, 2020, ALSWH	0.97198683	0.93389463	1.0116327
Dow, 2019, AusDiab	0.97647488	0.93957615	1.0148227
Chen, 2018, SCHS	0.96834642	0.9294408	1.0088806
Khalili-Moghadam, 2018, TLGS	0.9724946	0.93503714	1.0114527
Mamluk, 2017, EPIC-Elderly Greece	0.97100312	0.93137556	1.0123167
Mamluk, 2017, NIH-AARP	0.96091843	0.91534775	1.0087578
Mursu, 2014, KIHD	0.97635812	0.94005024	1.0140684
Kurotani, 2013, JPHC	0.97630608	0.93887144	1.0152333
Cooper, 2012, EPIC-InterAct	0.97318387	0.93363976	1.0144029
Bazzano, 2008, NHS	0.96153092	0.92085218	1.0040066
Villegas, 2008, SWHS	0.99993616	0.97983098	1.0204539
Montonen, 2005, FMCHES	0.97500229	0.93861377	1.0128015
Hodge, 2004, MCCS	0.97336245	0.93667936	1.0114821
Liu, 2004, WHS	0.96522117	0.92405063	1.008226
Meyer, 2000, IWHS	0.96597856	0.92734307	1.0062237
Combined	0.97284596	0.93630501	1.010813

Supplemental Figure 97. Influence analysis of fruits drinks and type 2 diabetes, dose-response



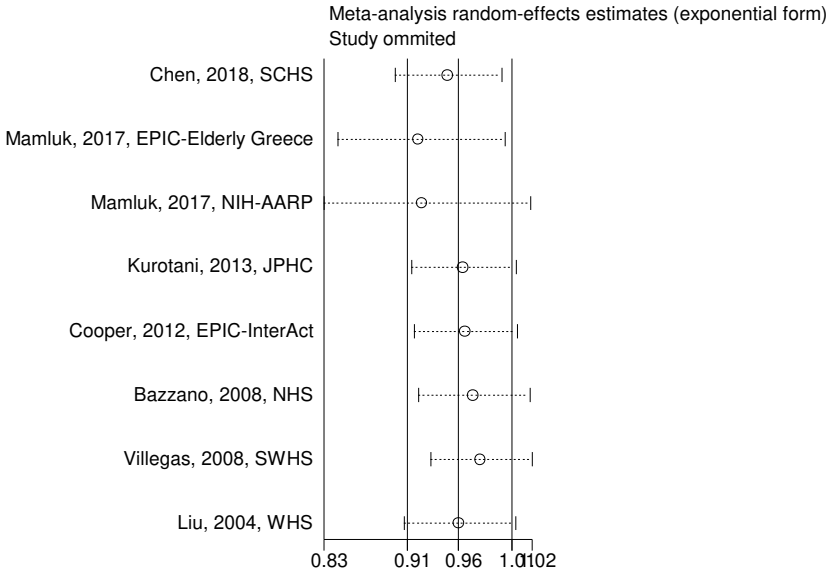
Study omitted	e^coef.	[95% Conf.	Interval]
Huang, 2017, WHI	1.1286894	0.99565953	1.2794933
Mursu, 2013, KIHD	1.1686578	1.0259602	1.3312026
Romaguera, 2013, EPIC-InterAct	1.17293181	1.0033647	1.3711554
De Koning, 2011, HPFS	1.1604002	1.0118947	1.3307
Palmer, 2008, BWHS	1.1695093	0.98227656	1.3924307
Montonen, 2007, FMCHES	1.1108766	1.0175979	1.2127057
Schulze, 2004, NHS II	1.0860962	0.98820531	1.193684
Combined	1.133824	1.0117585	1.2706163

Supplemental Figure 98. Influence analysis of cruciferous vegetables and type 2 diabetes, dose-response



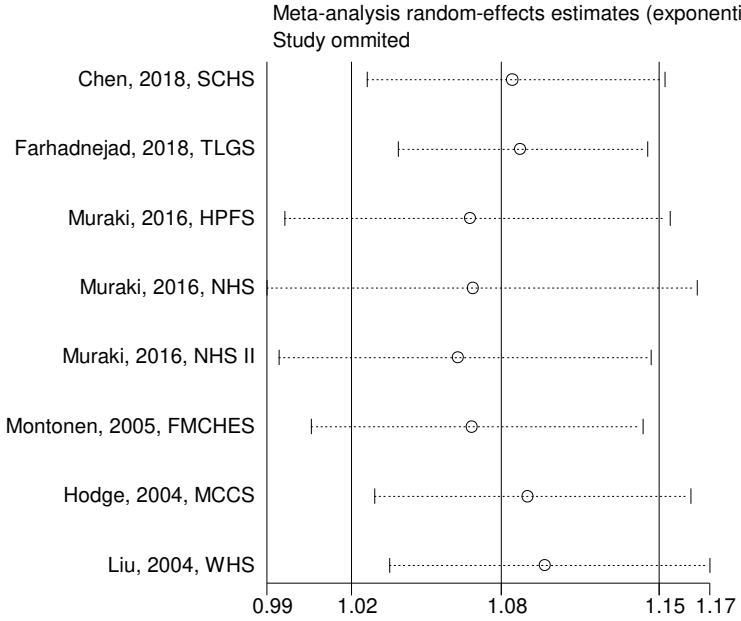
Study omitted	e^coef.	[95% Conf.	Interval]
Chen, 2018, SCHS	0.96210164	0.8343128	1.1094635
Ma, 2018, HPFS	0.91004604	0.77629888	1.0668364
Ma, 2018, NHS	0.90970498	0.77731478	1.0646435
Ma, 2018, NHS II	0.91330427	0.77489197	1.0764399
Mursu, 2014, KIHD	0.97963929	0.86384547	1.1109545
Kurotani, 2013, JPHC	0.96639293	0.84216845	1.1089413
Villegas, 2008, SWHS	1.0414906	0.95082915	1.1407964
Liu, 2004, WHS	0.95329195	0.82808661	1.0974281
Combined	0.95789886	0.84217237	1.0895278

Supplemental Figure 99. Influence analysis of green leafy vegetables and type 2 diabetes, dose-response



Study omitted	e^coef.	[95% Conf.	Interval]
Chen, 2018, SCHS	0.94474554	0.89619291	0.99592859
Mamluk, 2017, EPIC-Elderly Greece	0.9175899	0.84276497	0.99905813
Mamluk, 2017, NIH-AARP	0.92121667	0.82982373	1.0226753
Kurotani, 2013, JPHC	0.95928353	0.91180414	1.0092353
Cooper, 2012, EPIC-InterAct	0.96114069	0.91443449	1.0102326
Bazzano, 2008, NHS	0.96871805	0.91820931	1.0220052
Villegas, 2008, SWHS	0.97576261	0.9295674	1.0242535
Liu, 2004, WHS	0.95545352	0.90472227	1.0090294
Combined	0.95537042	0.90770012	1.0055443

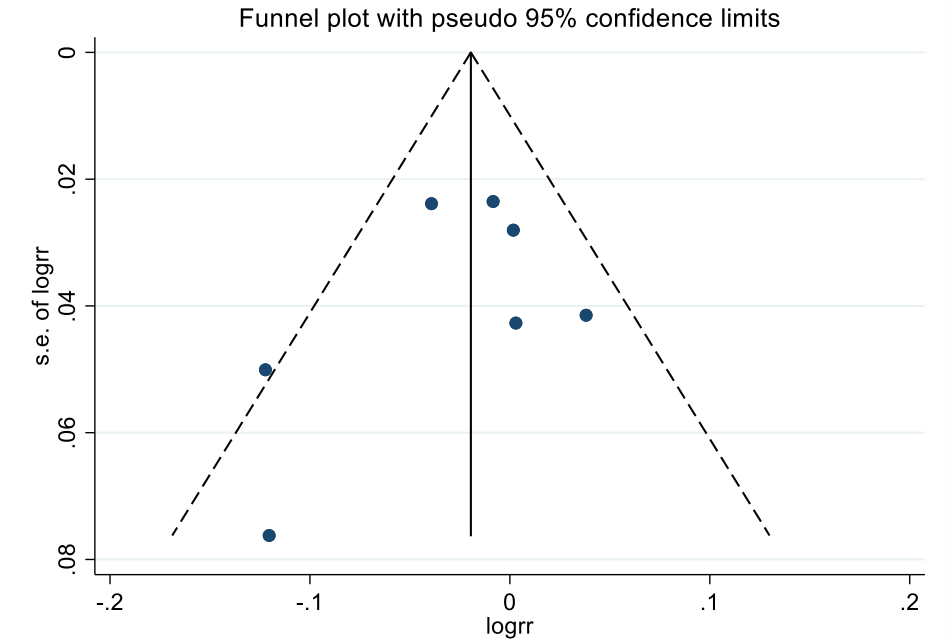
Supplemental Figure 100. Influence analysis of potatoes, total and type 2 diabetes, dose-response



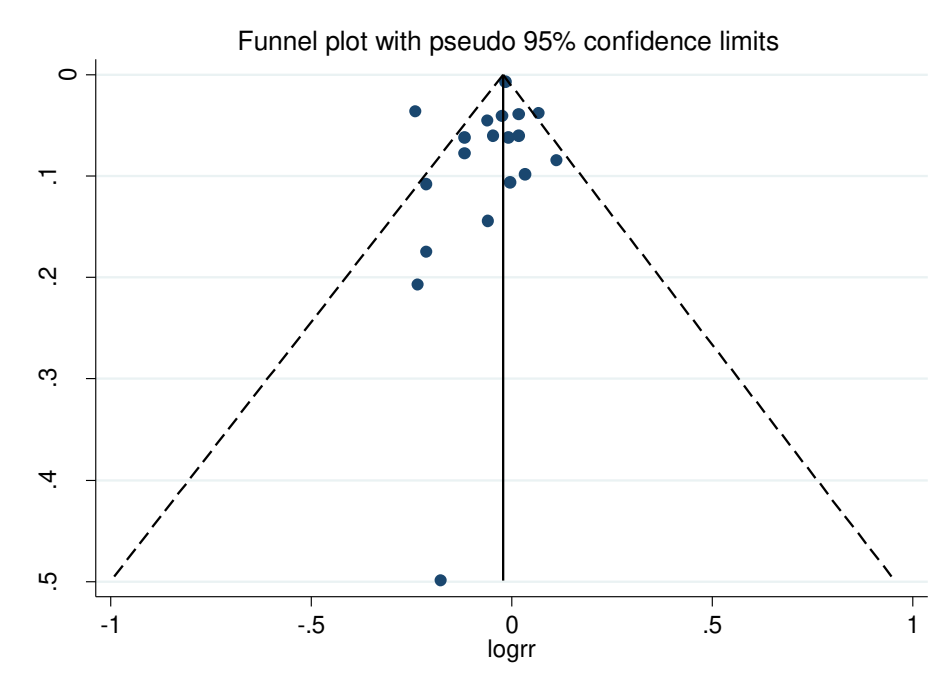
Study omitted	e^coef.	[95% Conf.	Interval]
Chen, 2018, SCHS	1.0865777	1.0277396	1.1487839
Farhadnejad, 2018, TLGS	1.089886	1.0403271	1.1418056
Muraki, 2016, HPFS	1.0696121	0.99405956	1.150907
Muraki, 2016, NHS	1.0707895	0.98676884	1.1619643
Muraki, 2016, NHS II	1.064756	0.99175006	1.1431361
Montonen, 2005, FMCHES	1.0703043	1.0049591	1.1398983
Hodge, 2004, MCCS	1.093115	1.0306273	1.1593915
Liu, 2004, WHS	1.0999411	1.0366597	1.1670854
Combined	1.0821336	1.0213531	1.1465311

Funnel plots

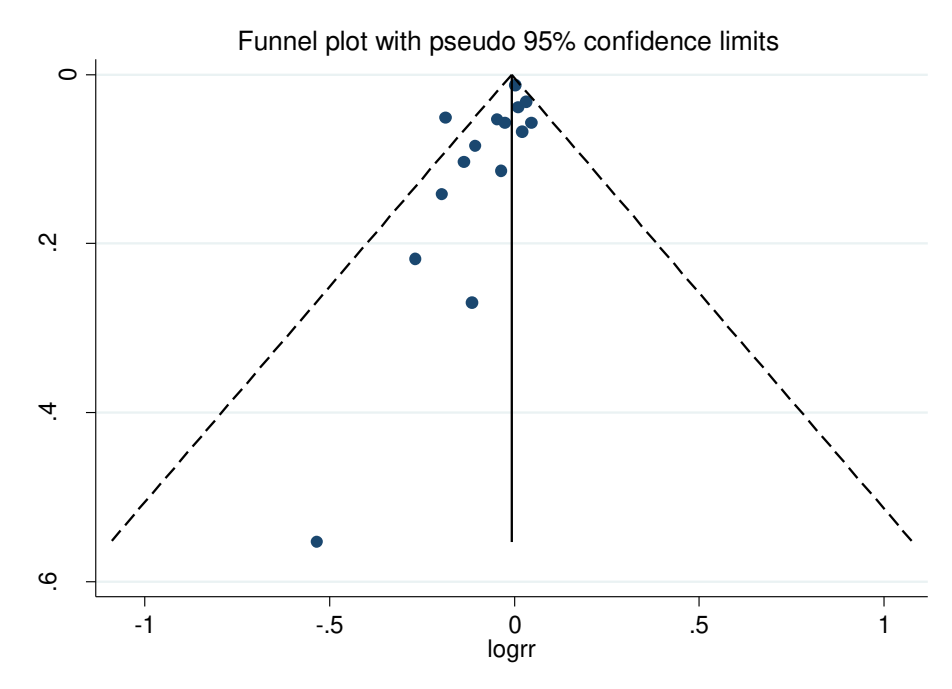
Supplemental Figure 101. Funnel plot of fruit and vegetables and type 2 diabetes



Supplemental Figure 102. Funnel plot of fruits and type 2 diabetes

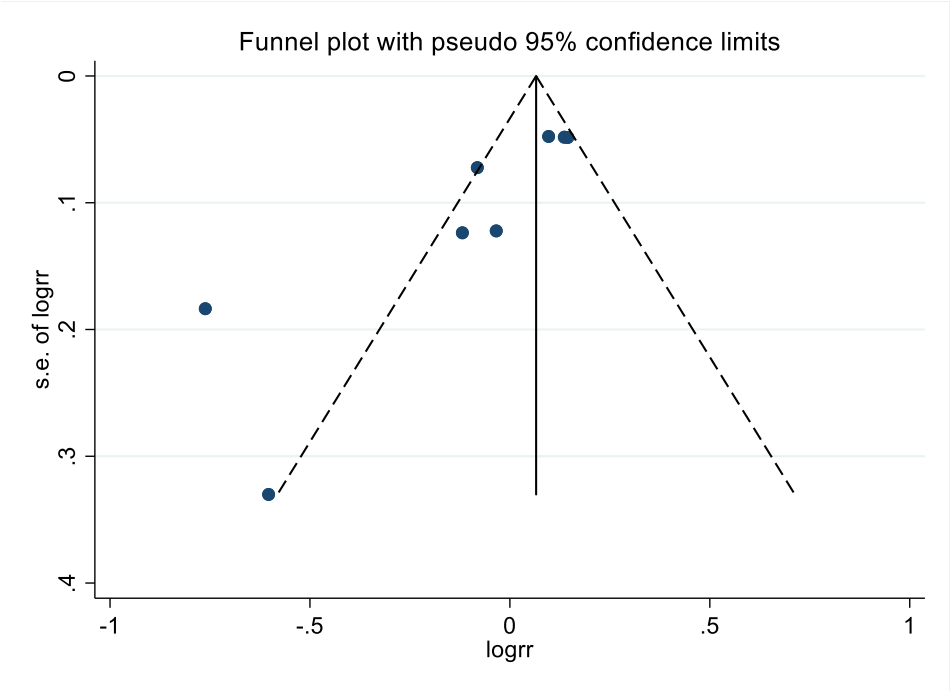


Supplemental Figure 103. Funnel plot of vegetables and type 2 diabetes



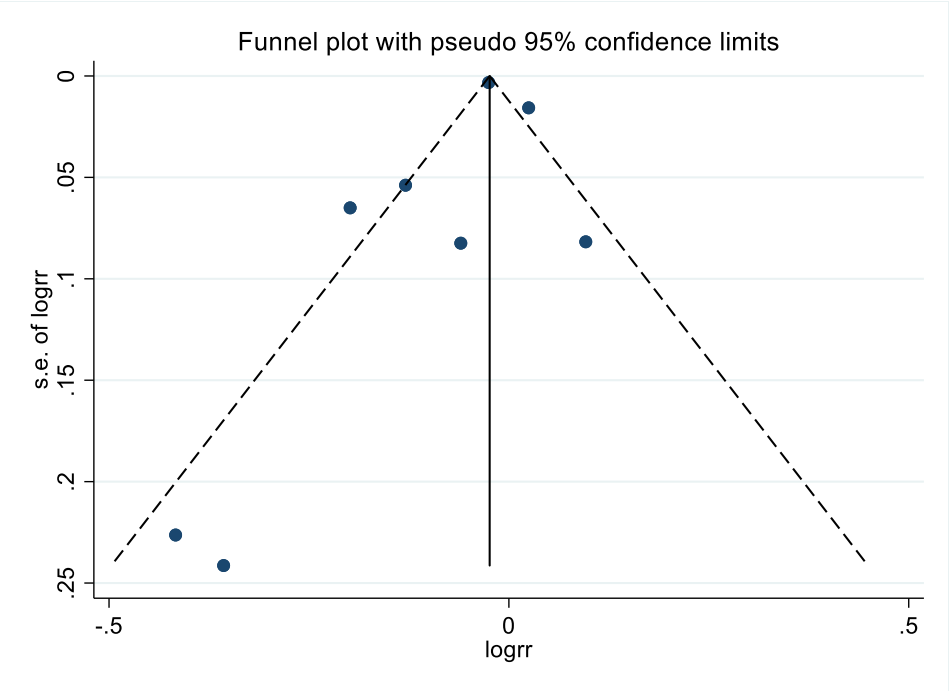
Neither Egger's test (changed from p=0.04 to p=0.06) nor the summary estimate (summary RR = 0.97 (0.93-1.01, $I^2 = 45.6\%$, $P = 0.04$) changed materially when excluding the study by Hodge et al., which appeared to be an outlier.

Supplemental Figure 104. Funnel plot of cruciferous vegetables and type 2 diabetes



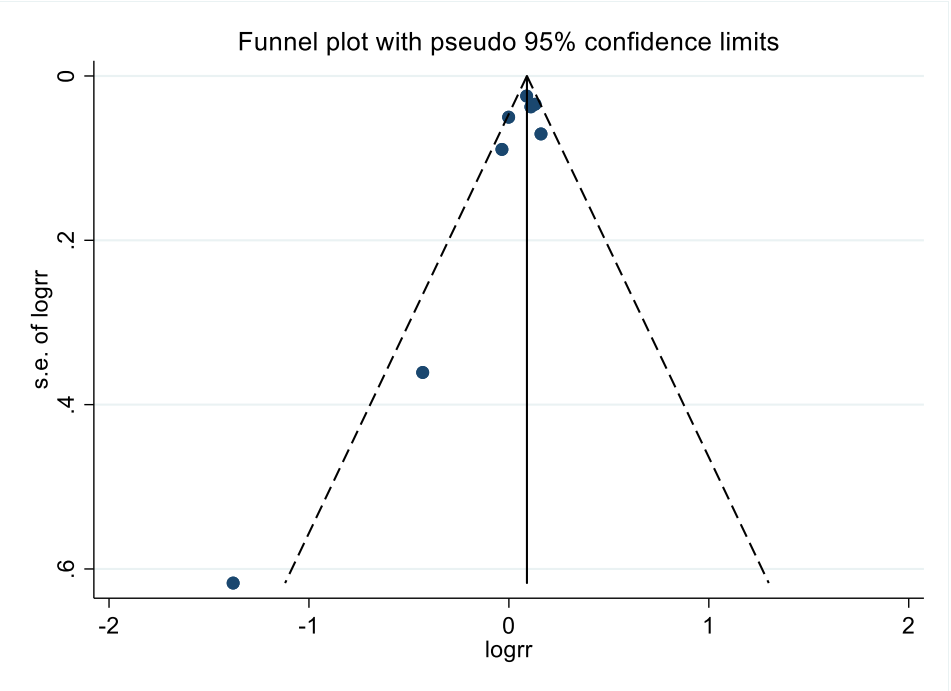
There was evidence of publication bias with Egger's test (P = 0.006), which remained significant (P = 0.05) after exclusion of two apparently outlying studies (Mursu et al. and Villegas et al.), and the association remained non-significant, summary RR=1.06 (95% CI: 0.98-1.15, I^2 = 57%), although the direction of the association changed.

Supplemental Figure 105. Funnel plot of green leafy vegetables and type 2 diabetes



Although Egger's test was not significant ($P = 0.46$), there was some indication of asymmetry in the funnel plot. This appeared to be driven by the studies of Cooper et al. and Kurotani et al. However, the results were not materially altered by exclusion of these two studies, summary RR = 0.96 (95% CI: 0.92-1.01, $I^2 = 78.4\%$).

Supplemental Figure 106. Funnel plot of potatoes, total and type 2 diabetes



Although there was indication of publication bias with Egger's test (P = 0.06) and by inspection of the funnel plot, the asymmetry in the funnel plot indicated missing positive studies. Excluding one outlying study by Farhadnejad et al. attenuated Egger's test to 0.23, but did not substantially alter the results, summary RR = 1.09 (95% CI: 1.04-1.14, I^2 = 40.2%, P = 0.12.