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Running Head: Diet in LMICs Review

How effective are interventions in improving dietary behaviour in Low and Middle Income countries? A systematic review and meta-analysis

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Abstract

Several interventions encouraging people to change their diet have been tested in low- and middle-income countries (LMICs) but these have not been meta-synthesised and it is not known which elements of these interventions contribute to their effectiveness. The current review addressed these issues. Randomized controlled trials of dietary interventions in LMICs were eligible and identified via 8 publication databases. Elements of both the intervention and comparison groups (e.g., behaviour change techniques (BCTs), delivery mode), participant characteristics and risk of bias were coded. Random effects meta-analysis of 76 RCTs found, on average, small- to medium-sized but highly heterogeneous improvement in dietary behaviour following intervention. Small and homogeneous improvements were found for BMI/weight, waist- and hip-circumference, with medium-sized, but heterogeneous, improvements in blood pressure and cholesterol. Although many BCTs have yet to be tested in this context, meta-regressions suggested some BCTs (action planning, self-monitoring of outcome(s) of behaviour; demonstration of behaviour) as well as individually-randomized trials, adult- or hypertensive-samples and lack of blinding were associated with larger dietary behaviour effect sizes. Interventions to encourage people from LMICs to change their diet produce, on average, small-to-medium-sized effects. These effects may possibly be increased through the inclusion of specific BCTs and other study elements.

Keywords: diet; systematic review; meta-analysis; behaviour change interventions; low-income countries; middle-income countries

Non-communicable diseases (NCDs) are a leading cause of death globally, and deaths from NCDs are projected to increase significantly (WHO, 2011). The burden of NCDs is highest in low- and middle-income countries (LMICs) where over three quarters of global NCD deaths [30.7 million] occurred in 2015 (WHO, 2017). Unhealthy diet (high in salt, sugar and fat and low in fruits and vegetables) is one of the established behavioural risk factors for LMICs (Bhandari, Angdembe, Dhimal, Neupane & Bhusal, 2014; WHO, 2015).

While numerous interventions to improve dietary behaviour have been assessed in LMICs (Aira, Wang, Riedel & Witte, 2013; Bhurosy & Jeewon, 2013; Cakir & Pinar, 2006; Paes-Barreto et al., 2013; Pan et al., 1997; Wang, Stewart, Chang & Shi, 2015), they have not been meta-synthesised and it is not known which element(s) of the intervention have the greatest impact on behaviour. This is not the case for high come countries (HICs) where reviews have identified potentially effective dietary behaviour-change techniques such as self-monitoring of behaviour, problem solving, social support and goal setting (Brannon & Cushing, 2015; Lara et al., 2014; Michie, Abraham, Whittington, McAteer & Gupta, 2009).

One previous review has synthesised evidence regarding the effects of interventions to improve healthy eating, physical activity and smoking behaviours amongst low-income groups, finding a positive but small effect on all three behaviours (Bull, Dombrowski, McCleary & Johnston, 2014). Although this review is useful in highlighting that such behaviours can be changed in low-income groups, it did not elucidate the elements of the interventions or studies that influenced the magnitude of the effects. Furthermore, of the sixteen interventions assessed, the majority were in the USA and only one was in a LMIC [Chile].

Focusing solely on interventions carried out in LMICs to improve dietary behaviour is important due to likely differences in the content of effective interventions delivered to HIC and LMIC populations, as well as the contexts they are delivered in. For example, behaviour change interventions in LMICs may not always be able to rely on written communications since key populations may have low literacy and/or there may be several local languages. With fewer tests and a lack of evidence synthesis, there is a risk that interventions shown to be effective in HICs are applied in LMICs. Cultural considerations are often not prioritised in public health interventions in LMICs where HIC-constructed theories and methodologies

may not be appropriate (Airhihenbuwa, 1995). However, there have been increasing attempts to make interventions contextually sensitive, such as in Nepal (KC et al., 2011; Shrestha et al., 2011), and in interventions designed to improve dietary behaviour within HICs (James, 2004; Resnicow et al., 2009).

In sum, previous reviews have not looked specifically at the effectiveness of behaviour change techniques in improving dietary behaviour of individuals residing in LMICs, or identified other elements of the study associated with effect sizes. Such elements include the intensity or duration of the intervention and characteristics of the sample, setting, comparison group or outcome measures used (Dombrowski, O'Carroll & Williams, 2016; Prestwich, Kenworthy & Conner, 2017). Some elements have been shown previously to be associated with the magnitude of health behaviour intervention effects such as the length or intensity of the intervention (e.g., Greaves et al., 2011), who delivers the intervention and the mode of delivery (e.g., Prestwich et al., 2017). Identifying such elements should enable the production of more successful interventions.

A further issue, as noted by Peters, de Bruin and Crutzen (2015), is that few reviews have taken into account the potential confounding between the elements of the intervention that appear to influence the treatment effect. Thus, certain elements of the intervention, such as specific behaviour change techniques, may only be related to treatment effect sizes because the element is delivered consistently with other elements. However, a small number of recent reviews of BCTs (e.g., Prestwich et al. 2014, 2016) have identified potentially effective study elements (e.g., specific BCTs or modes of delivery), assessed their co-occurrence and, when they co-occur, statistically controlled for each variable when testing the association between study elements and intervention effect sizes. If the elements remain significant predictors of effect sizes when controlling for one another, the elements are unlikely to be confounded. If the elements are rendered non-significant, the element(s) may be confounded. Taking these additional steps presents a more rigorous test of study and intervention elements and addresses in some way the issue of potential confounds.

Objectives

This review attempted to fill the gaps in the evidence base. Specifically, there were three objectives: (1) to synthesise the findings from studies testing the effect of interventions

(versus comparison conditions) on dietary behaviours of people living in LMICs; (2) to identify the behaviour change techniques and other elements that influence the effect of interventions on dietary behaviour; (3) to conduct a series of sensitivity analyses to test the impact of (a) the category of outcome variables used as a basis for effect size calculations; (b) outliers; (c) potential confounds between seemingly effective intervention elements; (d) risk of bias (including publication bias).

Method

This review was pre-registered in PROSPERO (registration number removed for blind review).

Search Strategy

A systematic search of the following eight databases was initially run in November 2015 and re-run in October 2017: Medline (Ovid), Embase (Ovid), PsycINFO (Ovid), Web of Science, The Cochrane Central Register of Controlled Trials (CENTRAL), CINAHL, Popline, Global Health (Ovid) (see Online Supplementary Material, Web Table 1). The search terms were based on established filters used in Ovid databases to identify RCTs (Higgins & Green, 2011; Scottish Intercollegiate Guidelines Network, 2014; The Cochrane Collaboration, 2016) and studies conducted in LMICs (Brown, van Urk, Waller & Mayo-Wilson, 2014; The Cochrane Collaboration, 2012). Additional search terms were used for healthy eating. Keyword searches were transferred between databases where possible, though we adapted search strategies to the specific controlled vocabularies used in every database. Subject heading searching was used in every database where this was possible. Techniques such as truncation were also used to maximise search results. The search was not limited by English language to provide the widest coverage possible and all databases were searched as far back as they allowed (start dates ranged from 1971 to 1996).

The titles and abstracts were double-screened using the eligibility criteria. Studies identified as eligible for inclusion were full-text double-screened. Any discrepancies were resolved through consensus. We contacted authors to obtain further details of papers containing insufficient information to make a decision about eligibility. If no response was provided, up to two reminders were sent and when possible one co-author was contacted.

Eligibility criteria

To be included in the review, studies had to: (1) use a Randomised Controlled Trial (RCT) design; (2) test the effects of an intervention to promote healthy eating or dietary behaviour even if this was not listed as the primary outcome; (3) assess dietary or healthy eating behaviour after at least some of the intervention had been delivered; (4) be tested in a LMIC [as defined by the World Bank economy classifications (The World Bank, 2017)] . Studies were excluded if they: (1) were not peer reviewed; (2) were protocols; (3) compared one type of diet against another; (4) promoted dietary supplements, vitamins, fasting, drugs or medical interventions; (5) included women who were pregnant or trying to conceive; or (6) were related to undernutrition.

Data Extraction

Studies were coded based on the published main trial paper and associated papers (e.g., protocol papers). The BCTs used in the interventions were coded by one reviewer using Michie et al.'s taxonomy of behaviour change techniques (2013) and checked by a second reviewer, with discrepancies discussed between the two reviewers to meet consensus. Both reviewers had completed the online BCT taxonomy training (BCT Taxonomy, 2015). Checks of statistical information (e.g., effect size calculations; corrections for clustering) were conducted by a co-author. Extracted data on bias were checked by a second reviewer and any discrepancies in decisions resolved by discussion and consensus. All coders were experienced in extracting data for systematic reviews. Statistical information were checked for all 76 studies; checks of other information were conducted on the first 55 studies (i.e., all studies identified in the initial search).

Characteristics of Interventions

The following data were extracted from the papers associated with each study: the specific BCTs used (according to Michie et al.'s (2013) taxonomy); the mode of delivery (face-to-face, Internet/PC, telephone, mail, printed materials, video based); the duration of the intervention (from first to last delivery, not including follow up); the time between the end of intervention and follow up where relevant; the setting (including country and city);

characteristics of the sample (including any pre-existing condition of the sample population). This data was extracted for intervention and control groups.

Assessment of risk of bias in included studies

The Cochrane Collaboration's tool for assessing risk of bias (Higgins & Green, 2011) was used. Data were extracted on randomisation, blinding, allocation concealment, selective outcome reporting and other bias concerns. Randomisation sequence generation was coded as low risk when randomisation methods such coin toss were recorded (otherwise, high risk). Blinding was assessed as adequate when a suitable method of blinding was employed. If blinding was not claimed, or it was judged that it could be easily broken, it was rated inadequate (high risk). Allocation concealment was coded as low risk of bias when it was judged that participants and researchers were unable to predict their allocation to a particular intervention. If an unconcealed procedure was used, it was coded as high risk. Selective outcome reporting was judged as low risk where the study protocols (or related papers) were available and expected outcomes were documented. Selective outcome reporting was classified as high risk where there were differences between measures specified pre-intervention and those reported after the intervention. For all of these risk of bias variables, a code of 'unclear' was assigned when relevant methods were not adequately described. Other bias concerns related to steps taken to reduce contamination, not obtaining informed consent or ethical approval, not using inclusion/exclusion criteria and attrition rates.

Data Synthesis

Comprehensive Meta-Analysis (Borenstein, Hedges, Higgins, Rothstein & Englewood, 2005) was used to calculate dietary and related outcome effect sizes (Hedges' g, based on means and standard deviations, SD). If SDs were not reported then standard errors (SE) or 95% confidence intervals were used to calculate standard deviations. If means or the aforementioned variability statistics were not available, means and standard deviations were estimated using medians and interquartile range (Wan, Wang, Liu & Tong, 2014). If these statistics were not available, other statistics were used (such as p values and sample sizes). For cluster trials, where the reported analyses did not take into account clustering, corrections were employed. For continuous outcomes, the effective sample sizes (derived by dividing

sample size by the design effect) were employed (the means and standard deviations remained the same). For proportion data, the standard errors for effect sizes were corrected (by multiplying the original standard error by the square root of the design effect) to avoid issues linked with rounding participants to whole numbers. In these calculations, the design effect was calculated using the formula: 1 + (M - 1) ICC, where M = the average cluster size (total sample size divided by the number of clusters) and ICC represents the intracluster correlation coefficients (Higgins & Green, 2011 p.16.3.4). When reported, the original ICCs were used, otherwise ICCs were estimated to be 0.05 (see Michie et al., 2009).

Effect sizes were calculated based on five types of dietary behaviour outcome: (1) self-reported behaviour and physiological measures closely linked with behaviour (e.g., blood sugar; cholesterol) which we treated as the primary outcome; (2) self-reported behaviour only; (3) self-reported behaviour, physiological measures closely linked with behaviour and more general outcomes linked with dietary behaviour (e.g., weight, fat mass); (4) self-reported fruit and vegetable intake; (5) self-reported fat intake. Physical outcomes (BMI/weight; waist and hip sizes; blood pressure; cholesterol) were also assessed as additional secondary outcomes.

Random-effects meta-analyses and random effects meta-regressions were conducted in STATA version 13.1 to ascertain overall effects and the association between study/intervention elements and effect sizes. In the meta-analyses, Hedges's g was used as the index of effect size as it is more appropriate than Cohen's d for small sample sizes. Effect sizes of .20, .50 and .80 are interpreted as small, medium and large effect sizes respectively (Cohen, 1988). Heterogeneity was assessed using the I^2 statistic; interpreting values of 25%, 50% and 75% as low, moderate and high levels of heterogeneity respectively (Higgins, Thompson, Deeks & Altman, 2003). In the meta-regressions, B reflects the change in the outcome variable (treatment effect sizes relating to diet) with one-unit increase in the predictor variables. For BCTs, a positive B indicates that studies that incorporate the specific BCT only in their intervention condition yield larger positive changes in diet effect sizes than studies that do not incorporate this BCT only in their intervention condition. A negative B indicates that studies using the specific BCT only in their intervention condition yield smaller

positive changes in diet effect sizes than studies not using this BCT uniquely in their intervention condition.

A series of sensitivity analyses were conducted to test the impact of (a) the choice of dependent variables used as a basis for effect size calculations (listed above) (b) removing outliers based on the Sample-Adjusted Meta-Analytic Deviancy (SAMD) Statistic (Huffcutt & Arthur, 1995) (c) potential confounding between seemingly effective elements; (d) risk of bias (including publication bias assessed using Egger's regression, Egger, Smith, Schneider & Minder, 1997).

Results

The numbers of studies considered at each stage of the review are shown in Figure 1.

Study characteristics

Across the 76 included studies, in roughly half participants had a pre-existing condition (k = 39). Most commonly, participants were overweight or obese (k = 17), had diabetes or impaired glucose intolerance (k = 10), or hypertension (k = 6). Thirty-seven studies were conducted on individual adults, 29 on individual children, 9 on family groups and one on a group of children. Educational (k = 37), medical (k = 20) and community (k = 15) settings were used most often. The studies were conducted in Asia (k = 26), South America (k = 21), the Middle East (k = 16), Africa (k = 10), Europe (k = 2) and the Caribbean (k = 1). The country with the most interventions was Brazil (k = 12), followed by Iran (k = 11) and China (k = 9). The average sample size of the studies was 267. The methodological quality of the studies was mixed. In 49 studies, randomisation was adequate. Furthermore, only 6 studies clearly reported that they used allocation concealment, 19 reported any form of blinding and 3 studies took measures to protect against contamination. The Online Supplementary Material Web Table 2 summarises the major characteristics of each study.

Syntheses of results

The primary meta-analyses were based on a combination of self-reported dietary behaviour and physiological outcomes directly linked with diet such as blood sugar and cholesterol,

henceforth referred to as the 'primary outcome' (k = 67). Of these studies, most comprised general measures of diet quality or combinations of multiple facets of diet (41 studies, 61.2%). The remaining studies comprised physiological measures directly linked with diet only (9 studies, 13.4%), self-reported measures of fruit and vegetable intake only (11 studies, 16.4%) or other (e.g., salt intake only, 6 studies, 9.0%). This index was chosen as the primary outcome as it reflects dietary behaviour defined broadly which maximises the number of studies included in the analyses. Moreover, comparing the sub-groups of measures in random effects meta-analysis suggested the effect sizes were similar across the measures (g = .35, g = .33, g = .35, g = .33, respectively). Meta-regressions formally revealed no association between the use of these 4 sub-types of dietary outcome (which were combined to create the primary outcome) and study effect size (all p's > .81; with outliers excluded all p's > .38). Overall, meta-analyses of 67 studies revealed small-to-medium sized improvement in the primary outcome attributable to the intervention (g = .35, 95% CI = .27, .42), and high heterogeneity in effect sizes (I^2 = 76.6%, $\chi^2(66) = 281.63$, $p < .001$) (see Figure 2). When outliers were removed, the effect size was smaller (g = .31, 95% CI = .24, .37) with moderate-to-high heterogeneity (I^2 = 62.0%, $\chi^2(63) = 165.72$, $p < .001$).

Effect of BCTs on dietary behaviour

Across all studies, 50 out of the 93 BCTs listed in the BCT Taxonomy v1 were not differentially employed across the experimental and comparison groups; thus these BCTs were not testable. For reasons of power, reducing multiplicity and ease of interpretation, the reported analyses are based only on BCTs used differentially across the experimental and comparison groups in at least 4 studies (> 5% of all studies). Regarding ease of interpretation, for example, social support (emotional) emerged as being associated with larger effect sizes in some of the analyses. However, this BCT was used solely in the intervention in one study. Evidence supporting the use of this BCT to promote healthy dietary intake in LMICs, therefore, remains particularly limited. The full dataset is provided online should readers wish to explore the BCTs used less often. Applying the 5% criterion left 20 testable BCTs.

After removing the outliers, action planning (BCT 1.4) and self-monitoring of outcome(s) of behaviour (BCT 2.4) were significantly associated with the primary outcome

such that studies that incorporated these BCTs within their intervention conditions (and not in the comparison conditions) produced greater improvement in dietary behaviour than those which did not (see Table 1).

Effect of other intervention elements/study characteristics on dietary behaviour

On the primary outcome, larger effect sizes were generated in studies targeting adults rather than children, individually randomized trials (versus cluster trials) and in studies not reporting any form of blinding and in those specifically failing to blind the data analyst. Larger effect sizes were also reported in studies conducted in the Middle East and in hypertensives, with smaller effects in face-to-face interventions but none of these predictors were robust when outliers were removed (see Table 2).

Sensitivity analyses 1 and 2: Effect of category of dependent variable and Outliers

Outliers were identified using scree plots (see Online Supplementary Material, Web Figure 1). Removing these outliers impacted the findings in several ways (the results with the outliers removed are presented in parentheses). Compared to the effect sizes based on the primary outcome, the overall improvements in dietary behaviour arising from intervention were similar when based only on self-reported dietary outcomes, g = .36, 95% CI = .27, .44 (g = .31, 95% CI = .24, .38). When the outcomes were expanded to the broadest index (self-reported dietary outcomes, physiological outcomes directly linked to diet (e.g., blood sugar and cholesterol) and more distal outcomes (e.g., weight, shape and blood pressure) combined), g = .32, 95% CI = .25, .39 (g = .26, 95% CI = .21, .31) or focused on self-reported fruit and vegetable intake only, g = .30, 95% CI = .20, .41 (g = .24, 95% CI = .16, .32), the effect sizes representing the extent to which dietary behaviour improved following intervention were slightly smaller. These effect sizes were smallest when based on self-reported fat intake, g = .21, 95% CI = .07, .35 (g = .13, 95% CI = .03, .24). In all instances, heterogeneity was high prior to outlier removal: broadest index of diet, $I^2 = 75.9\%$, $\chi^2(75) = 310.70$, $p < .001$; self-reported diet, $I^2 = 78.7\%$, $\chi^2(57) = 267.39$, $p < .001$, fruit and vegetable intake, $I^2 = 75.4\%$, $\chi^2(28) = 113.87$, $p < .001$; fat intake, $I^2 = 81.5\%$, $\chi^2(23) = 124.04$, $p < .001$, and more moderate when outliers were removed: broadest index of diet ($I^2 = 47.6\%$, $\chi^2(71) = 135.56$, $p < .001$); self-reported diet ($I^2 = 64.4\%$, $\chi^2(54) = 151.48$, $p < .001$), fruit and

vegetable intake (I^2 = 49.4%, $\chi^2(27) = 53.34$, p = .002), and fat intake (I^2 = 61.9%, $\chi^2(21) = 55.08$, p < .001).

The effects of action planning (BCT 1.4) were robust across all secondary behavioural outcomes except fat intake for which there were fewest tests (see Table 2). Self-monitoring of outcome(s) of behaviour (BCT 2.4), which was positively associated with the primary outcome, became non-significant across all of the other outcomes. However, demonstration of behaviour (BCT 6.1) was at least marginally positively associated with effect size for three of the secondary outcomes. A few other BCTs were positively associated with effect size (e.g., goal setting, BCT 1.1) but these effects were driven by a small number of outlier studies on the secondary outcomes (with their effects becoming non-significant when the outliers were removed). Two BCTs (social support (practical) BCT 3.2; re-structuring the physical environment, BCT 12.1) were negatively associated with fruit and vegetable outcomes suggesting interventions that comprised these BCTs for this particular type of outcome yielded smaller effects than interventions not comprising these BCTs.

Aside from the fat intake outcome (which consisted of the fewest tests), the effects of non-BCT study characteristics on the secondary outcomes were similar to those on the primary outcome. Specifically, the effects of the intervention target (adults versus children) and randomization type (cluster versus individual) were robust across the three remaining secondary outcomes (self-reported diet, combining all outcomes, self-reported fruit and vegetable intake). Studies targeting hypertensives also generated larger effect sizes on two secondary outcomes (the combined outcome and fruit and vegetable intake). Blinding (data analyst; intervention deliverer) reduced two secondary outcome effect sizes (combined outcome; self-reported diet). Studies conducted in the Middle East again produced larger effect sizes only when outliers were included (and only on the self-reported fruit and vegetable intake outcome).

Sensitivity analysis 3: Confounding between potentially effective elements

Given the impact of outliers on of the effects of BCTs on dietary outcomes, the analyses controlling for confounders were conducted only on outcomes with outliers removed. The associations between effective study elements were examined using the Chi-square test (applying Fisher's exact test where appropriate; see Table 3).

Action planning (BCT 1.4) was more likely to be applied uniquely in the intervention condition within individually randomized trials than cluster trials. When accounting for this in multivariate meta-regressions, action planning was a marginally significant predictor (the primary outcome: B = .14, SE = .08, p = .09; self-reported diet: B = .14, SE = .08, p = .09; fruit and vegetable intake: B = .25, SE = .13, p = .07). Self-monitoring of outcomes of behaviour (BCT 2.4) and demonstration of the behaviour (BCT 6.1) were unrelated with other significant elements and thus were at limited risk of confounding.

In addition, children were more likely to participate in cluster trials than adults. When these variables were entered together, the pattern of results varied across measures. They rendered each other non-significant (for the primary outcome and self-reported diet) or only intervention target (for the 'all outcomes' index, B = .07, SE = .03, p = .03) or type of randomization (for fruit and vegetable intake, B = .19, SE = .09, p = .03) were significant.

Sensitivity Analysis 4: Risk of bias (including publication bias)

Studies that claimed blinding (any form, of the data analyst or of the person delivering the intervention) yielded smaller effect sizes in at least some of the analyses. However, these risk of bias elements were unrelated to other elements of the studies that were found to be positively related with study effect size (see Table 3). Thus, risk of bias was not co-varied alongside other study elements that influenced effect sizes.

Egger's regression suggested that there was a risk of publication bias (p = .004) (see Figure 3). When accounting for this using trim-and-fill analysis, the effect of dietary interventions on dietary behaviour was reduced to a small but still significant effect size (g = .19, 95% CI = .10, .27).

Physical outcomes

Several studies examined intervention effects on a number of physical outcomes. These revealed largely small effects. Where the effect sizes were heterogeneous we checked for outliers (results with outliers removed are presented in parentheses).

Overall, small, homogenous effects were detected for the effect of interventions on BMI/weight, g = .15, 95% CI = .09, .21, k = 41, I^2 = 25.7%, $\chi^2(40) = 53.86$, p = .07; waist

size, g = .20, 95% CI = .11, .29, k = 17, I^2 = 0%, $\chi^2(16)$ = 13.92, p = .61, and hip size, g = .20, 95% CI = .02, .37, k = 6, I^2 = 45.7%, $\chi^2(5)$ = 9.21, p = .10. Larger but highly heterogeneous effect sizes were detected for blood pressure, g = .52, 95% CI = .28, .75, k = 16, I^2 = 92.0%, $\chi^2(15)$ = 187.87, p < .001 (g = .31, 95% CI = .16, .46, k = 15) and cholesterol, g = .40, 95% CI = .22, .58, k = 17, I^2 = 80.9%, $\chi^2(16)$ = 83.7, p < .001 (g = .43, 95% CI = .25, .61, k = 16).

Discussion

Approximately half of the studies (33/67) produced effects of interventions on the primary dietary behaviour outcome that were reasonably small (g < .30), rising to more than half of the studies (44/76) based on the broader index of dietary behaviour. While suggesting it can be difficult to promote healthy dietary behaviour in LMICs, the overall effect size was small-to-medium on average and the effects were significantly heterogeneous. As such, under certain circumstances, larger (and smaller) effects can be achieved. Significant heterogeneity could be partly attributable to variations in the behavioural outcomes across studies but the average effect sizes for the four different types of behavioural outcomes were remarkably similar (g = .33 - .35). The heterogeneity could also be reflective of meaningful differences in intervention content, participant or other study characteristics. Indeed, our findings suggest action planning (BCT 1.4), self-monitoring of outcome(s) of behaviour (BCT 2.4) and demonstration of the behaviour (BCT 6.1) may increase the effects of the interventions on dietary behaviour. Other BCTs emerged as significant predictors in some analyses but were driven by outliers. Studies that did not use blinding, randomized individuals or targeted adults also produced larger intervention effects. However, these elements were unrelated or had little impact on the three potentially effective BCTs (1.4, 2.4 and 6.1) suggesting the effects of the BCTs on dietary outcomes were not confounded with other (non-BCT) study elements. The effects of the interventions on specific physical outcomes (BMI/weight, waist- and hip-size) were consistently small, displaying non-significant heterogeneity.

While it is difficult to compare across studies given variations in inclusion/exclusion and other characteristics, the findings of this review are somewhat consistent with the findings from reviews which have looked at the effectiveness of BCTs in dietary interventions, or behaviour more broadly, in high income country contexts. The BCTs found to be most effective in our review have received similar support in diet and other health

behaviour reviews focused primarily in HICs (self-monitoring: Harkin et al., 2016; Michie et al., 2009; demonstration of the behaviour: French et al., 2014; Hartmann-Boyce et al., 2014; action planning: Adriaanse, Vinkers, De Ridder, Hox & De Wit, 2011; Prestwich, Sheeran, Webb & Gollwitzer, 2015).

In some of our analyses, larger effects were seen in hypertensives, which may suggest a more urgent desire for such populations to improve their dietary behaviour. Intensity, duration, mode of delivery or the type of personnel delivering the intervention had little impact on the magnitude of dietary intervention effects. Although caution is necessary when interpreting null effects, similar effects across different modes of delivery and levels of intensity suggest governments and health departments could consider implementing the effective BCTs identified in our review even when resources are scarce, selecting contextually and culturally appropriate modes or methods that meet feasibility criteria for public health interventions in LMICs (Walley et al., 2010). Similarly, as effect sizes were equivocal when the intervention targeted multiple health behaviours or just diet, it may be more beneficial to target dietary behaviours alongside other health behaviours, especially were doing so requires little or no extra cost.

Due to the potential risk of confounding and the use of multiple combinations of different elements within complex interventions (although analyses were conducted to identify and control the most important confounds), our analyses are best described as hypothesis-generating rather than hypothesis-confirming. The present review highlights potentially effective BCTs to improve dietary behaviour of people living in LMICs but further testing using full- or fractional-factorial designs is warranted. Moreover, lack of support for a particular BCT is potentially attributable to limited power and/or small effect size. Some techniques such as goal setting outcome (BCT 1.3) may be effective in these contexts but no study in this review explored them. These unexplored BCTs might, or might not, prove effective when used on their own, or in combination with other techniques, to improve dietary behaviour in LMICs. Specifically, despite including 76 studies in the meta-analysis, 50 out of a possible 93 BCTs were not testable for the primary outcome and only 20

BCTs were utilized uniquely in either the intervention or comparison condition in at least 4 studies. Thus, most BCTs were used very infrequently, if at all.

In the absence of systematic coding of the theoretical basis of the dietary interventions and its application using a suitable method (e.g., the Theory Coding Scheme, Michie & Prestwich, 2010), and the potential difficulties of analysing such data such as poor reporting in the primary studies (see Prestwich, Webb, & Conner, 2015), we can only offer tentative suggestions about the utility of specific types of theory. Theories which are consistent with the use of action planning (as a specific form of goal-setting) and monitoring of goal progress such as Carver and Scheier's (1982) Control Theory may provide a useful basis for dietary interventions in LMICs. However, experimental tests of such theories are needed to confirm its potential in LMICs, taking account of other Control Theory-consistent BCTs including feedback on current performance versus set goals which can catalyse improved performance.

The review has further limitations. First, there is a possibility that coding errors were made as coding BCTs according to Michie et al.'s taxonomy (2013) can be subject to errors due to the subjectivity of coders (Wood et al., 2015). However, this review took measures to minimise potential coding and/or interpretative errors by ensuring all coding was checked by a second reviewer and that components within comparison conditions were also coded and accounted for within the analyses. Taking account of the content of the comparison condition has not always been done in other reviews looking at whether BCTs can positively affect health behaviours (Dombrowski et al., 2012; Michie et al., 2009). There is also the assumption that what is reported in the articles accurately represents what actually happened in each RCT. This may not be the case because of inadequate fidelity and/or reporting which would serve to potentially reduce the strength of the detected associations between study elements and effect size. We attempted to minimise the impact of inadequate reporting by also taking into account in our coding any materials (e.g., protocols, secondary outcome papers) reporting additional methodological or statistical details.

Second, unpublished studies were not considered. A lack of unpublished studies may mean that the effects calculated in this review have been overestimated on the basis that unpublished studies may be more likely to show non-significant effects. However, non-

published articles lack peer review and, when incorporated into BCT reviews, may be more likely to contain incomplete or insufficient information which reduces the reliability of coding. Furthermore, despite evidence of some publication bias in this review, the effect of interventions on dietary behaviour remained significant when publication bias was accounted for in the effect size estimate.

Third, varied outcome measures were used to assess the wide-ranging interventions. To control for this issue, we categorised the outcomes in five ways (self-reported measures only (e.g., portions of fruit consumed daily); self-reported measures plus physiological measures closely linked with dietary behaviour (such as blood glucose levels); self-reported measures, dietary behaviour-related physiological measures and other physiological measures (such as blood pressure) combined; self-reported fruit and vegetable intake only; self-reported fat intake only) and considered the impact of these categorisations in sensitivity analyses. Moreover, the sub-types of outcome which were combined for the primary outcome did not differ in their effect size according to meta-regression analyses.

Finally, we did not examine the effects of combinations of BCTs. Statistical approaches (e.g., meta-CART; Li, Dusseldorp & Meulman, 2017) can consider interactions but require large number of studies that include interventions that combine the desired BCTs.

This review is, to the best of our knowledge, the first to consider the effectiveness of BCTs and other intervention elements for dietary behaviour changes in LMICs and has several key findings. First, the interventions produce, on average, small-to-medium sized improvements in dietary behaviour. Second, how the intervention is delivered (the BCTs utilized, the type of randomization) can influence the degree of dietary behaviour change; future dietary interventions conducted in LMICs may benefit from utilising action planning, demonstrating the behaviour and self-monitoring of the outcome(s) of behaviour. Third, the effects may vary depending on to whom the intervention was delivered (with larger effects for hypertensives and adults). Fourth, other intervention or study characteristics (such as mode of delivery) were largely unrelated with dietary intervention effects. Fifth, the majority of BCTs from Michie et al.'s (2009) taxonomy were not testable within the meta-analyses and thus warrant further examination. Finally, comparing across reviews, BCTs which improve diet in

HICs may be similarly effective in LMICs. This review, therefore, may aid those who wish to develop more effective dietary change interventions in LMICs and highlights evidence gaps.

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Table 1: Meta-regressions. BCTs regressed on dietary behaviour effect sizes

	Use of each BCT across all studies included in the review (k = 76)			**Self-report & physiological outcomes directly linked with behaviour**						**Self-reported diet only**					
				Inc. outliers (k = 67)			Exc. outliers (k = 64)			Inc. outliers (k = 58)			Exc. outliers (k = 55)		
	Intervention only (+1)	Neither condition or both (0)	Control only (-1)	beta	Std. error	p-value	beta	Std. error	p-value	beta	Std. error	p-value	beta	Std. error	p-value
1.1 Goal setting (behaviour)	17	58	1	.13	.09	.16	.10	.08	.21	.05	.12	.65	.00	.10	.98
1.2 Problem solving	12	64	0	-.01	.12	.96	.03	.09	.72	-.02	.12	.86	.03	.10	.73
1.4 Action planning	13	63	0	.16	.10	.12	.20	.08	.02*	.17	.13	.18	.21	.10	.03*
2.3 Self-monitoring of behaviour	9	66	1	.10	.14	.49	.12	.11	.29	.07	.16	.65	.11	.13	.38
2.4 Self-monitoring of outcome(s) of behaviour	6	70	0	.31	.18	.096†	.38	.15	.01*	.05	.21	.80	.13	.16	.44
2.7 Feedback on outcomes of behaviour	7	69	0	-.03	.16	.84	.02	.13	.90	-.06	.16	.70	.00	.13	.98
3.1 Social support (unspecified)	30	46	0	.07	.09	.45	.05	.07	.45	.11	.10	.26	.09	.08	.25
3.2 Social support (practical)	9	67	0	-.12	.11	.28	-.09	.09	.31	-.17	.12	.17	-.13	.09	.18
4.1 Instruction on how to perform a behaviour	54	21	1	-.08	.08	.35	-.08	.07	.25	-.04	.09	.67	-.04	.08	.65
5.1 Information about health consequences	22	54	0	.06	.09	.47	-.04	.07	.63	.06	.10	.53	-.05	.08	.56
5.2 Salience of consequences	4	72	0	.19	.16	.24	.03	.14	.85	.18	.17	.30	.02	.15	.88
5.3 Information about social and environmental consequences	7	69	0	.19	.14	.18	.09	.13	.48	.30	.16	.06†	.19	.14	.21
6.1 Demonstration of the behaviour	10	66	0	.12	.12	.34	.15	.10	.13	.11	.13	.40	.16	.10	.14
7.1 Prompts/cues	20	56	0	.03	.09	.78	-.03	.08	.68	.05	.10	.60	-.01	.08	.90
8.1 Behavioural practice/rehearsal	15	61	0	-.04	.10	.71	-.01	.08	.92	-.05	.11	.64	-.01	.09	.87
8.2 Behaviour substitution	4	72	0	.05	.18	.80	.06	.14	,66	.04	.19	.84	.06	.15	.68
9.1 Credible source	32	44	0	-.10	.08	.22	-.06	.07	.41	-.13	.09	.18	-.07	.08	.33
10.3 Non-specific reward	4	72	0	.20	.19	.29	-.06	.19	.74	.18	.20	.36	-.07	.20	.72
12.1 Restructuring the physical environment	13	63	0	-.07	.11	.49	-.05	.08	.58	-.08	.12	.48	-.05	.09	.60
12.5 Adding objects to the environment	4	72	0	-.21	.16	.20	-.18	.12	.14	-.22	.17	.20	-.19	.13	.14

Table 1 (Continued): Meta-regressions. BCTs regressed on dietary behaviour effect sizes

	All outcomes						**Self-reported fruit and vegetables intake**						**Self-reported fat intake**					
	Inc. outliers (k = 76)			Exc. outliers (k = 72)			Inc. outliers (k = 29)			Exc. outliers (k = 28)			Inc. outliers (k = 24)			Exc. outliers (k = 22)		
	beta	Std. error	p-value	beta	Std. error	p-value	Beta	Std. error	p-value	beta	Std. error	p-value	beta	Std. error	p-value	beta	Std. error	p-value
1.1 Goal setting (behaviour)	.16	.11	.13	.05	.07	.47	.24	.11	.048*	.13	.10	.21	.03	.18	.86	-.08	.14	.58
1.2 Problem solving	.09	.13	.49	.00	.08	1	-.16	.13	.24	-.10	.10	.36	.00	.19	.99	-.16	.17	.35
1.4 Action planning	.23	.12	.06†	.14	.07	.06†	.27	.17	.11	.35	.12	.01*	.18	.25	.48	-.18	.23	.44
2.3 Self-monitoring of behaviour	.04	.13	.74	.08	.07	.28	.08	.22	.74	.14	.17	.41	-.02	.23	.94	.06	.17	.71
2.4 Self-monitoring of outcome(s) of behaviour	.05	.18	.77	.14	.10	.16	-.21	.23	.37	-.15	.19	.42	-.02	.31	.95	.07	.25	.78
2.7 Feedback on outcomes of behaviour	-.11	.16	.51	-.03	.09	.79	.04	.19	.85	.11	.15	.48	-.30	.24	.22	-.22	.19	.26
3.1 Social support (unspecified)	.07	.10	.47	.01	.06	.88	.23	.11	.048*	.13	.09	.16	-.08	.16	.64	.04	.13	.74
3.2 Social support (practical)	-.14	.13	.29	-.09	.07	.19	-.24	.12	.05†	-.18	.08	.04*	.16	.22	.47	-.06	.20	.78
4.1 Instruction on how to perform a behaviour	-.10	.09	.29	-.05	.06	.35	-.11	.11	.29	-.04	.09	.66	.12	.17	.47	.00	.13	.98
5.1 Information about health consequences	.05	.10	.66	-.02	.06	.77	.01	.12	.90	-.05	.09	.55	-.19	.17	.27	-.08	.13	.56
5.2 Salience of consequences	.13	.19	.50	-.03	.11	.79	.26	.16	.11	-.01	.15	.97	.35	.42	.42	.43	.33	.22
5.3 Information about social and environmental consequences	.11	.16	.51	.02	.10	.81	.72	.16	.000*	.51	.30	.10	.38	..30	.21	-.18	.33	.60
6.1 Demonstration of the behaviour	.27	.14	.07†	.12	.09	.17	.14	.14	.31	.18	.10	.09†	.36	.23	.14	.45	.17	.01*
7.1 Prompts/cues	-.01	.11	.93	-.04	.06	.49	.00	.12	.97	.07	.09	.43	-.19	.16	.25	-.09	.13	.50
8.1 Behavioural practice/rehearsal	.00	.12	1	-.07	.06	.29	-.11	.12	.36	-.07	.09	.42	.04	.18	.85	.14	.14	.32
8.2 Behaviour substitution	.04	.21	.85	.07	.12	.55	-.07	.18	.69	-.03	.13	.82	.21	.22	.36	-.05	.22	.84
9.1 Credible source	-.02	.09	.82	-.02	.05	.73	-.11	.12	.38	-.05	.09	.56	-.24	.15	.13	-.13	.12	.31
10.3 Non-specific reward	.08	.20	.67	-.07	.13	.58	.53	.19	.01*	-.18	.36	.61	.10	.35	.77	.19	.24	.44
12.1 Restructuring the physical environment	-.10	.12	.40	-.04	.06	.51	-.23	.11	.05†	-.17	.08	.047*	.24	.18	.20	.16	.16	.33
12.5 Adding objects to the environment	-.21	.19	.26	-.16	.09	.08†	-.18	.15	.23	-.13	.10	.22	-.01	.28	.98	.04	.21	.84

Table 2: Effect of other intervention characteristics

Intervention characteristic	Frequency of characteristic (k = 76)			**Self-report & physiological outcomes directly linked with behaviour**						**Self-reported diet only**					
				Inc. outliers (k = 67)			Exc. outliers (k = 64)			Inc. outliers (k = 58)			Exc. outliers (k = 55)		
TYPE OF PARTICIPANT	1	0	-1	Beta	Std. err.	p-value	beta	Std. error	p-value	Beta	Std. error	p-value	Beta	Std. err.	p-value
Pre-existing condition (yes/no)	39	37	-	.11	.08	.18	.03	.07	.64	.14	.09	.14	.03	.08	.63
Overweight (yes = 1/no = 0)	17	56	-	-.01	.12	.91	-.11	.11	.31	.01	.14	.93	-.09	.12	.47
Hypertension (yes = 1/no = 0)	6	67	-	.41	.16	.01*	.16	.16	.31	.65	.21	.002*	.28	.23	.22
Diabetes (yes = 1/no = 0)	7	66	-	.11	.14	.45	.18	.11	.12	.18	.19	.35	.25	.15	.10
Individual vs. group (1=individual, 0=group)	66	10	-	.10	.13	.44	.07	.10	.49	.03	.14	.84	-.01	.12	.91
Adult vs. child (1=adult, 0=both, -1=child)	37	9	30	.14	.04	.001*	.10	.03	.004*	.15	.05	.003*	.10	.04	.01*
Family (yes = 1/no = 0)	9	67	-	-.12	.13	.36	-.10	.11	.37	-.05	.15	.75	-.01	.12	.96
SETTING															
Asia (yes = 1/no = 0)	26	50	-	-.11	.09	.23	-.02	.07	.76	-.11	.10	.26	-.01	.08	.89
Africa (yes = 1/no = 0)	10	66	-	-.04	.12	.72	-.02	.09	.86	.00	.14	1	.03	.11	.81
Middle East (yes = 1/no = 0)	16	60	-	.22	.10	.04*	.03	.10	.78	.29	.11	.02*	.07	.11	.50
South America (yes = 1/no = 0)	21	55	-	-.05	.10	.62	-.01	.08	.90	-.07	.11	.51	-.03	.09	.71
INTERVENTION/other study CHARACTERISTICS															
Preparation (yes = 1/no = 0)	15	61	0	.00	.11	.97	-.09	.09	.30	.06	.12	.64	-.06	.10	.58
Targeted multiple behaviours (1=multi-behaviour; 0=diet only)	45	29	-	.01	.09	.91	.01	.07	.91	.01	.10	.94	.00	.08	.99
Follow-up without BCTs (yes = 1/no = 0)	18	58	-	-.10	.10	.30	-.06	.08	.49	-.09	.11	.42	-.04	.09	.69
Period of intervention days [experimental]	-	-	-	-.00	.00	.40	.00	.00	.53	.00	.00	.38	.00	.00	.51
Face to face [experimental] (yes = 1/no = 0]	70	6	-	-.33	.15	.03*	-.11	.14	.41	-.32	.17	.06†	-.07	.15	.66
Computer-based [experimental] (yes = 1/no = 0)	6	70	-	.03	.17	.86	.07	.14	.62	-.02	.17	89	.02	.13	.87
Telephone-based [experimental] (yes = 1/no = 0)	10	66	-	.09	.11	.43	.00	.09	1	.17	.14	.21	.02	.11	.84
Print-based [experimental] (yes = 1/no = 0)	63	13	-	-.10	.11	.38	.00	.09	.98	-.08	.13	.56	.07	.10	.50
Video-based [experimental] (yes = 1/no = 0)	8	68	-	-.06	.12	.61	.00	.10	.99	-.07	.13	.58	.00	.11	1
Face to face [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	55	20	1	-.12	.08	.17	-.03	.07	.62	-.18	.10	.08†	-.05	.09	.54

Computer-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	5	71	-	.03	.17	.86	.07	.14	.62	-.02	.17	.89	.02	.13	.87
Telephone-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	9	67	-	.12	.11	.31	.02	.09	.86	.17	.14	.21	.02	.11	.84
Print-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	44	31	1	-.05	.08	.56	.03	.07	.68	-.10	.10	.31	.01	.08	.94
Video-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	8	67	1	-.06	.11	.63	.00	.10	.99	-.04	.12	.75	.02	.10	.86
RISK OF BIAS/METHODOLOGY 1 = low risk; 0 = high or unclear risk of bias															
Type of randomisation [individual vs. group] (1=individual, 0=group)	38	38	-	.24	.08	.003*	.19	.06	.005*	.24	.09	.009*	.17	.07	.03*
Adequate randomization (1 = yes/0 = no)	49	27	-	-.01	.09	.93	.04	.08	.60	.02	.10	.88	.07	.08	.42
Allocation concealment [claimed] (1 = yes/0 = no)	6	70	-	-.15	.15	.32	-.12	.12	.31	-.13	.19	.51	-.10	.14	.51
Allocation concealment [adequate] (1 = yes/0 = no)	4	72	-	-.18	.19	.36	-.14	.15	.36	-.15	.31	.62	-.11	.22	.63
Any blinding [claimed] (1 = yes/0 = no)	19	57	-	-.18	.09	.04*	-.15	.07	.04*	-.18	.11	.09†	-.15	.08	.09†
Blinding Participants [claimed] (1 = yes/0 = no)	6	70	-	-.21	.13	.12	-.18	.10	.08†	-.13	.15	.39	-.11	.12	.36
Blinding Deliverer [claimed] (1 = yes/0 = no)	8	68	-	-.17	.12	.16	-.14	.10	.16	-.26	.14	.06†	-.22	.11	.04*
Blinding Data Collector [claimed] (1 = yes/0 = no)	5	71	-	.03	.16	.86	.04	.12	.76	.20	.22	.37	-.15	.16	.36
Blinding Analysis [claimed] (1 = yes/0 = no)	5	71	-	-.27	.15	.08†	-.23	.12	.048*	-.13	.20	.51	-.11	.15	.49
Contamination prevention [claimed] (1 = yes/0 = no)	3	72	-	-.13	.20	.54	-.12	.16	.48	.10	.28	.72	.15	.24	.53
Contamination prevention [adequate] (1 = yes/0 = no)	1	75	-	.05	.38	.90	.09	.33	.78	.04	.39	.92	.09	.33	.80
Informed consent (1 = yes/0 = no)	73	3	-	-.19	.27	.48	-.23	.24	.34	-.18	.27	.52	-.22	.24	.36
Attrition rate [experimental]	-	-	-	.00	.00	.53	.00	.00	.17	.00	.00	.83	.00	.00	.41
Ethics approval reported (1 = yes/0 = no)	67	9	-	-.04	.14	.78	-.06	.11	.61	-.02	.14	.89	-.05	.12	.70

Table 2 (Continued): Effect of other intervention characteristics

Intervention characteristic	All outcomes						Self-reported fruit and vegetable intake						Self-reported fat intake					
	Inc. outliers (k = 76)			Exc. outliers (k = 72)			Inc. outliers (k = 29)			Exc. outliers (k = 28)			Inc. outliers (k = 24)			Exc. outliers (k = 22)		
TYPE OF PARTICIPANT	beta	Std. err	p-value	beta	Std. err.	p-value	beta	Std. error	p-value	beta	Std. error	p-value	Beta	Std. err.	p-value	beta	Std. err.	p-value
Pre-existing condition (yes/no)	.04	.09	.63	.02	.05	.67	.24	.12	.05†	.12	.11	.28	.01	.16	.94	.02	.13	.90
Overweight (yes = 1/no = 0)	-.06	.12	.51	-.07	.07	.32	.27	.14	.06†	.09	.13	.52	-.14	.19	.46	-.27	.14	.07†
Hypertension (yes = 1/no = 0)	.40	.18	.03*	.15	.13	.25	.59	.32	.08†	.66	.25	.02*	-	-	-	-	-	-
Diabetes (yes = 1/no = 0)	.04	.17	.83	.16	.09	.099†	-.09	.33	.79	-.03	.28	.91	.20	.29	.49	.31	.21	.16
Individual vs. group (1=individual, 0=group)	.08	.15	.58	.03	.08	.71	.07	.16	.65	.02	.13	.89	-.06	.21	.78	-.15	.15	.34
Adult vs. child (1=adult, 0=both, -1=child)	.14	.04	.002*	.09	.03	.002*	.14	.05	.02*	.10	.04	.03*	.00	.08	.98	.01	.07	.85
Family (yes = 1/no = 0)	-.09	.15	.57	-.04	.09	.65	-.10	.18	.59	-.04	.14	.76	-.03	.23	.89	.07	.17	.70
SETTING																		
Asia (yes = 1/no = 0)	-.07	.10	.44	-.05	.06	.41	-.03	.12	.80	.01	.09	.93	-.14	.16	.38	.01	.13	.96
Africa (yes = 1/no = 0)	-.01	.14	.94	.03	.07	.67	-.10	.17	.56	-.04	.13	.74	-.18	.27	.52	-.10	.21	.63
Middle East (yes = 1/no = 0)	.20	.11	.07†	.06	.07	.45	.37	.12	.005*	.23	.12	.08†	-.07	.24	.77	.00	.18	.99
South America (yes = 1/no = 0)	-.09	.11	.40	-.02	.06	.73	-.12	.12	.36	-.06	.10	.53	.22	.16	.20	-.03	.15	.85
INTERVENTION/other study CHARACTERISTICS																		
Preparation (yes = 1/no = 0)	.04	.12	.76	-.02	.07	.79	-.13	.14	.37	-.08	.11	.50	.08	.25	.76	.13	.20	.50
Targeted multiple behaviours (1=multi-behaviour; 0=diet only)	-.07	.10	.50	-.02	.05	.69	-.10	.11	.37	-.02	.09	.82	.01	.16	.97	.06	.13	.68
Follow-up without BCTs (yes = 1/no = 0)	-.06	.11	.56	-.01	.06	.89	.02	.12	.88	.06	.09	.54	.01	.19	.95	-.12	.15	.43
Period of intervention days [experimental]	.00	.00	.40	.00	.00	.49	.00	.00	.19	.00	.00	.35	.00	.00	.60	.00	.00	.68
Face to face [experimental] (yes = 1/no = 0]	-.29	.18	.10	-.08	.12	.48	-.10	.22	.66	-.17	.17	.34	-.07	.27	.80	-.16	.19	.41
Computer-based [experimental] (yes = 1/no = 0)	-.06	.17	.74	.02	.09	.87	.01	.16	.93	.06	.12	.63	.19	.22	.40	-.02	.21	.92
Telephone-based [experimental] (yes = 1/no = 0)	.06	.13	.67	.00	.07	.98	.04	.17	.84	.09	.13	.48	-.19	.19	.33	-.09	.15	.54
Print-based [experimental] (yes = 1/no = 0)	-.09	.12	.46	-.03	.07	.68	.11	.14	.43	.08	.11	.44	.22	.24	.38	.14	.19	.48
Video-based [experimental] (yes = 1/no = 0)	-.05	.15	.74	.02	.08	.83	-.14	.14	.30	-.10	.10	.32	.30	.19	.13	.17	.18	.35
Face to face [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	-.09	.09	.32	-.06	.06	.32	-.17	.13	.20	-.04	.11	.72	.22	.20	.29	.11	.16	.49
Computer-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	.00	.19	.98	.08	.10	.45	.01	.16	.93	.06	.12	.63	.19	.22	.40	-.02	.21	.92

Telephone-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	.08	.13	.55	.01	.08	.90	.04	.17	.84	.09	.13	.48	-.19	.19	.33	-.09	.15	.54
Print-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	-.08	.09	.36	.01	.05	.82	.01	.12	.96	.09	.09	.33	.18	.17	.29	.07	.13	.61
Video-based [experimental v control] (inter.only=1/both/neither=0/con.only=-1)	-.04	.14	.76	.01	.08	.87	-.07	.12	.59	-.05	.09	.59	.21	.17	.22	.09	.15	.56
RISK OF BIAS/METHODOLOGY																		
1 = low risk; 0 = high or unclear risk of bias																		
Type of randomisation [individual vs. group] (1=individual, 0=group)	.21	.09	.02*	.14	.05	.01*	.31	.10	.004*	.24	.08	.008*	.02	.16	.92	.00	.13	.98
Adequate randomization	-.07	.10	.47	.05	.06	.39	-.29	.13	.03*	-.12	.12	.33	.06	.19	.76	-.03	.15	.86
Allocation concealment [claimed]	-.16	.16	.33	-.09	.09	.29	-.10	.26	.71	-.04	.18	.81	-	-	-	-	-	-
Allocation concealment [adequate]	-.16	.20	.43	-.08	.11	.48	-.10	.26	.71	-.04	.18	.81	-	-	-	-	-	-
Any blinding [claimed]	-.18	.10	.09†	-.11	.06	.06†	-.02	.14	.90	.03	.10	.75	.04	.19	.83	-.10	.16	.55
Blinding Participants [claimed]	-.17	.15	.29	-.11	.08	.15	-.06	.16	.69	-.02	.12	.84	.36	.28	.21	-.05	.26	.84
Blinding Deliverer [claimed]	-.18	.14	.20	-.12	.08	.13	-.14	.17	.42	-.08	.12	.54	-.16	.23	.50	-.07	.18	.71
Blinding Data Collector [claimed]	-.04	.18	.82	-.01	.10	.91	-.15	.19	.45	-.09	.14	.53	-.13	.36	.71	-.05	.26	.84
Blinding Analysis [claimed]	-.26	.17	.12	-.18	.09	.04*	.21	.29	.48	.27	.22	.22	-.22	.37	.56	-.13	.28	.63
Contamination prevention [claimed]	-.04	.24	.86	-.02	.14	.86	.06	.26	.83	.12	.22	.61	.21	.42	.62	.29	.34	.40
Contamination prevention [adequate]	.07	.44	.87	.14	.29	.62	.08	.35	.82	.14	.30	.65	.21	.42	.62	.29	.34	.40
Informed consent	-.21	.31	.49	-.28	.22	.21	-.04	.31	.91	-.10	.27	.71	-.21	.42	.62	-.29	.34	.40
Attrition rate [experimental]	.00	.00	.54	.00	.00	.13	.00	.00	.92	.00	.00	.35	.00	.01	.72	.00	.01	.57
Ethics approval reported	-.06	.15	.69	-.09	.09	.32	.08	.16	.61	.02	.13	.86	.13	.21	.55	.04	.17	.82

Table 3: Confounding of Behaviour Change Techniques (k = 76)

Behaviour change technique	1	2	3	4	5	6	7	8	9
1. Action planning (BCT 1.4)	-	1	.06†	.25	.06†	.03*	1	.34	.58
2. Self-monitoring (outcome) (BCT 2.4)		-	1	.36	.91	.67	1	1	1
3. Demonstration of the behaviour (BCT 6.1)			-	1	.98	1	.06†	.59	1
4. Hypertension				-	.16	.098†	.18	1	.36
5. Adult vs. child					-	.000**	.92	.66	.83
6. Type of randomization						-	.43	.71	.36
7. Any blinding [claimed]							-	.000**	.001**
8. Blinding deliverer [claimed]								-	.44
9. Blinding analysis [claimed]									-

Note: The table denotes p-values. *p < .05; **p < .01; †p < .10. k = the number of studies included in the analyses.

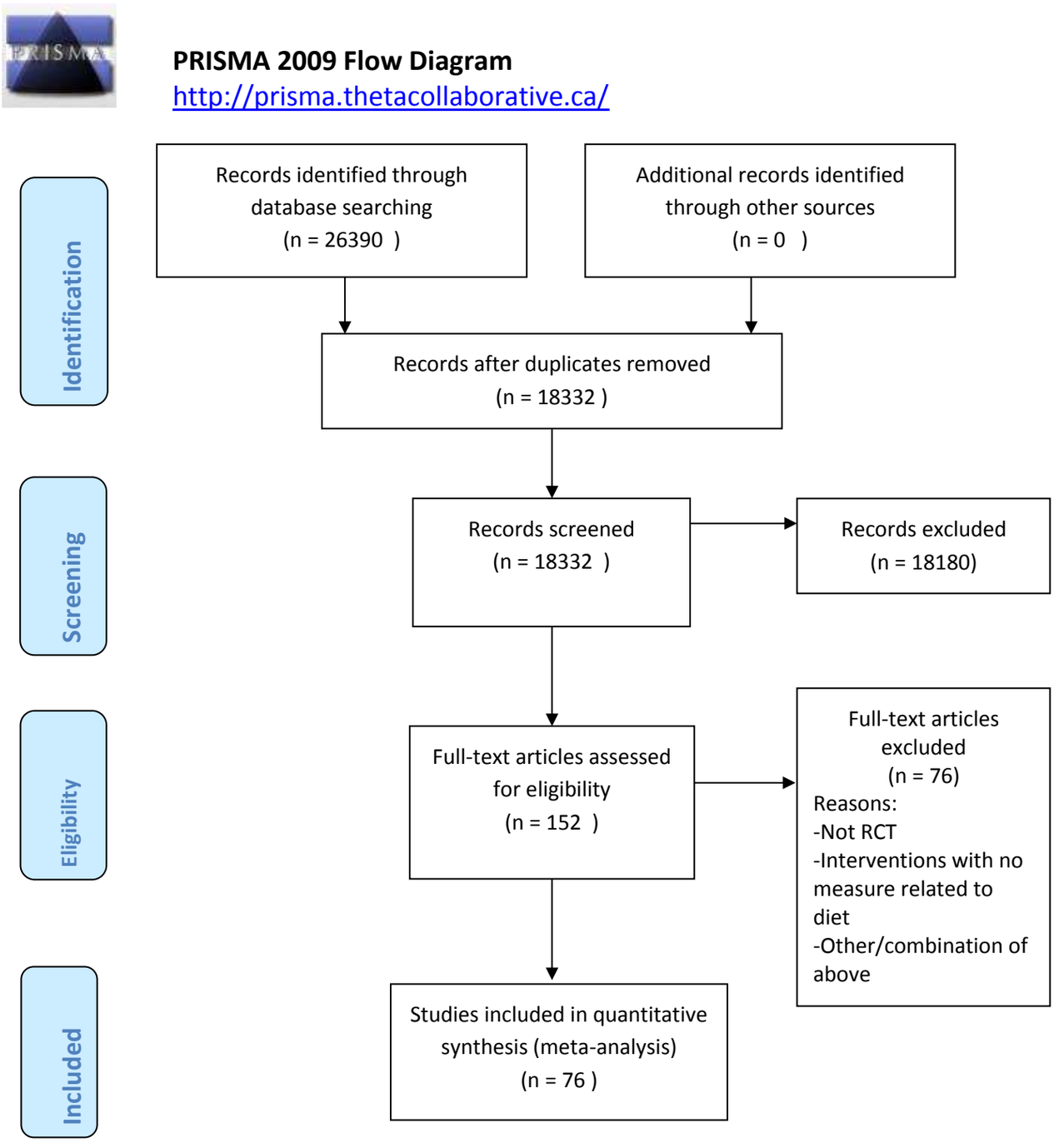

Figure 1: PRISMA flow diagram

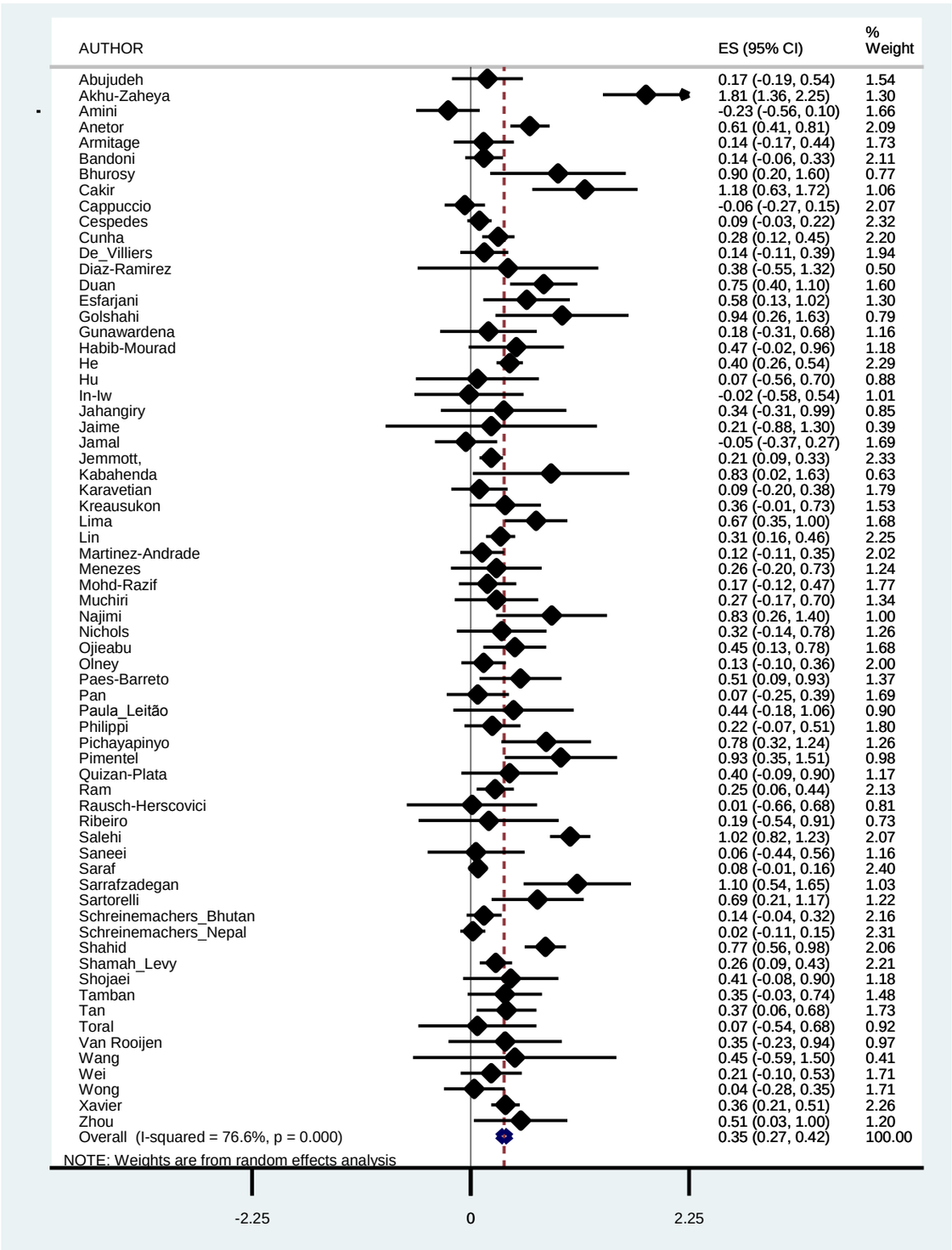

Figure 2: Forest plot of intervention effect sizes (self-report and physiological outcomes directly linked with dietary behaviour, k = 67)

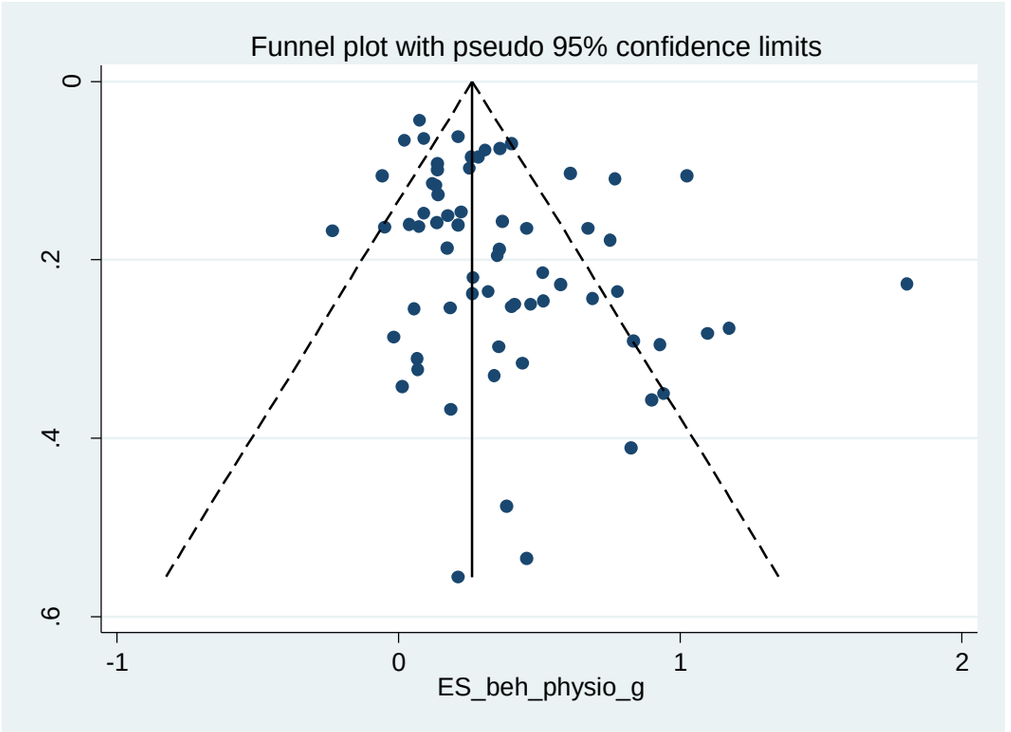

Figure 3: Funnel plot of observed effect size on self-report and physiological outcomes directly linked with dietary behaviour (ES_beh_physio_g) against standard error (SE_beh_physio_g).

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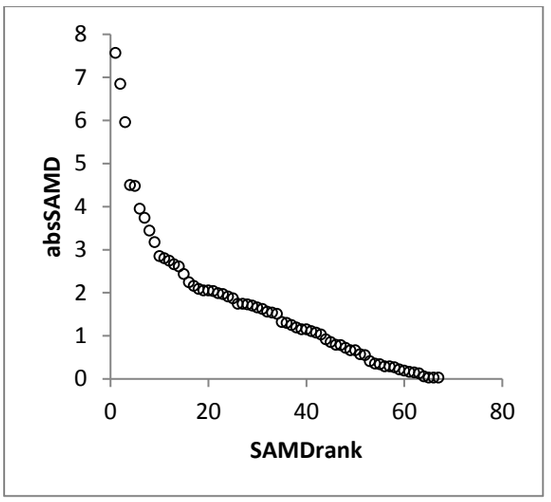
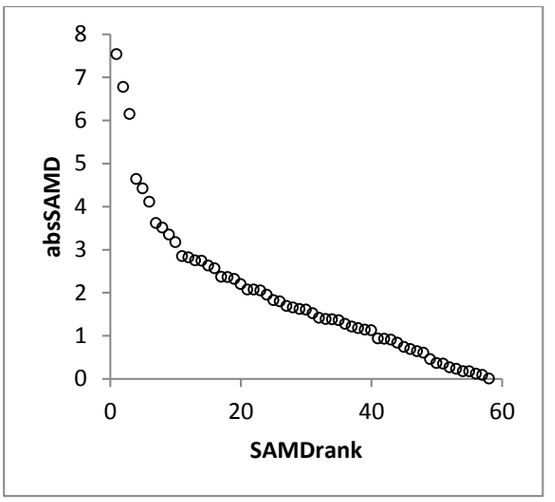
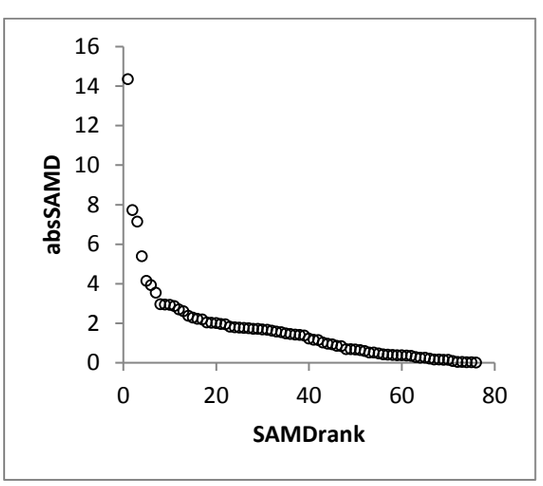


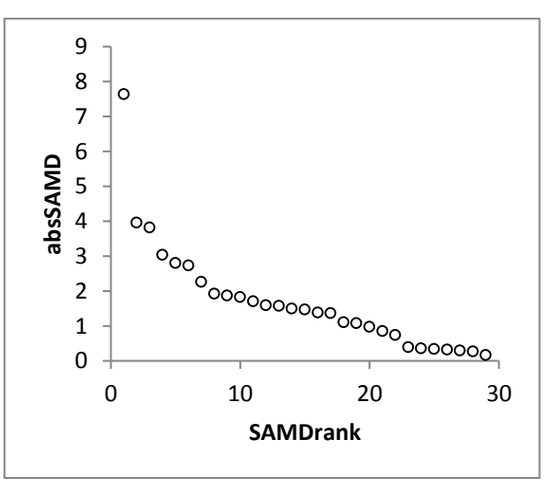
Web Figure 1.1: Self-report and physiological outcomes directly linked with behaviour



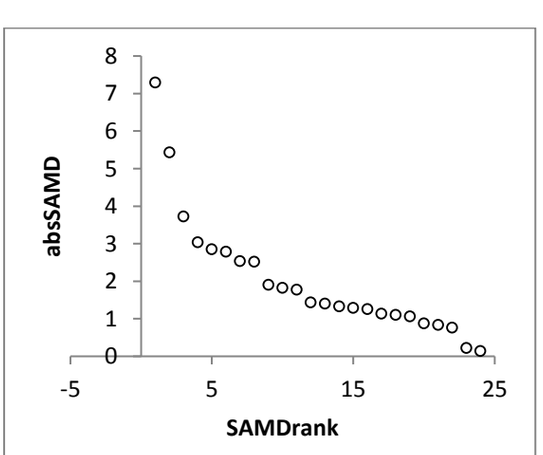
Web Figure 1.2: Self-report outcomes only



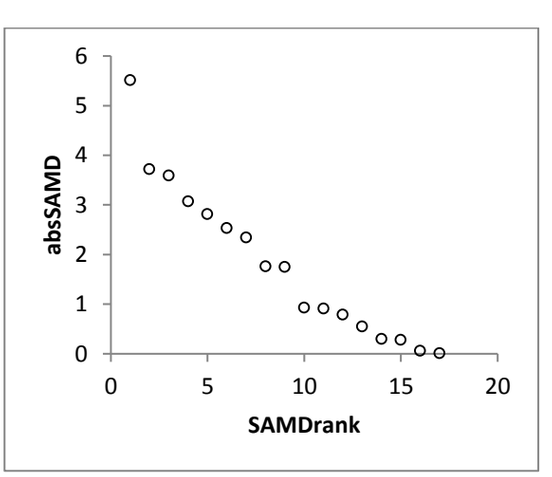
Web Figure 1.3: All outcomes



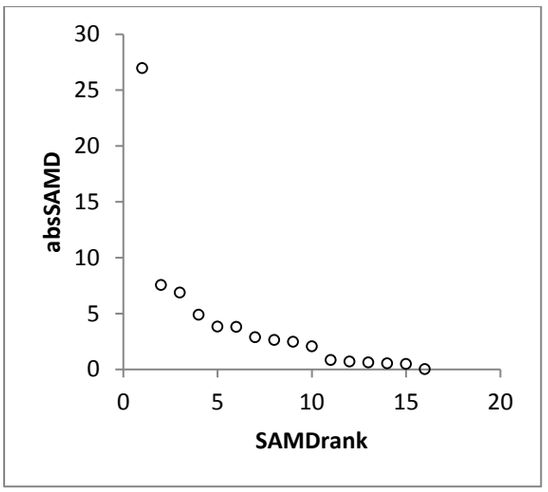
Web Figure 1.4: Self-reported fruit and vegetable intake



Web Figure 1.5: Self-reported fat intake



Web Figure 1.6: Cholesterol



Web Figure 1.7: Blood pressure

Online Supplementary Material, Web Figure 1: Scree plots SAMD study rank (SAMDrank) with SAMD score (absSAMD)

Online Supplementary Material, Web Table 1: Search strategies

PsycINFO
1 (Africa or Asia or Caribbean or West Indies or South America or Latin America or Central America).hw,kf,ti,ab,cp. (27599)
2 (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe).mp. or Rhodesia.hw,kf,ti,ab,cp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (177744)
3 ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab. (12309)

4 ((developing or less* developed or under developed or underdeveloped or middle income or low* income) adj (economy or economies)).ti,ab. (248)
5 (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. (28)
6 (low adj3 middle adj3 countr*).ti,ab. (1469)
7 (lmic or lmics or third world or lami countr*).ti,ab. (1157)
8 transitional countr*.ti,ab. (50)
9 Developing Countries/ (4463)
10 exp developing countries/ (4463)
11 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 (196794)
12 Clinical trial/ (9197)
13 CONTROLLED TRIAL.mp. (16730)
14 RCT.mp. (2552)
15 (RANDOM* adj3 TRIAL).mp. (23187)
16 (CLIN* adj3 TRIAL).mp. (11046)
17 (SING* adj2 BLIND*).mp. (1826)
18 (DOUB* adj2 BLIND*).mp. (19947)
19 PLACEBO.mp. or exp PLACEBO/ (33638)
20 LATIN SQUARE.mp. (470)
21 (RANDOM* adj2 ASSIGN*).mp. (30609)
22 PROSPECTIVE STUDIES/ (481)
23 (PROSPECTIVE adj STUD*).mp. (12331)
24 (COMPARATIVE adj STUD*).mp. (12587)
25 TREATMENT EFFECTIVENESS EVALUATION/ (19332)
26 (EVALUATION adj STUD*).mp. (2221)
27 exp POSTTREATMENT FOLLOWUP/ (1127)
28 FOLLOW?UP STUD*.mp. (12779)
29 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 (146410)
30 diet*.ti,ab. (32409)
31 healthy eat*.tw. (1817)
32 diets/ or drinking behavior/ or eating behavior/ or health behavior/ or nutrition/ or obesity/ (57755)
33 eating behavio?r*.tw. (6397)
34 Fruit/ (3041)

35 fruit*.ti,ab. (13996)
36 Vegetables/ (0)
37 vegetable*.ti,ab. (4033)
38 salt*.ti,ab. (4749)
39 oil*.ti,ab. (3759)
40 or/30-39 (98118)
41 11 and 29 and 40 (257)
42 limit 41 to (english language and yr="1990 -Current") (238)

The Cochrane Central Register of Controlled Trials (CENTRAL)

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1 (Africa or Asia or Caribbean or "West Indies" or "South America" or "Latin America" or "Central America"):ti,ab,kw
2 (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or "Burkina Faso" or "Burkina Fasso" or "Upper Volta" or Burundi or Urundi or Cambodia or "Khmer Republic" or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or "Cape Verde" or "Central African Republic" or Chad or Chile or China or Colombia or Comoros or "Comoro Islands" or Comores or Mayotte or Congo or Zaire or "Costa Rica" or "Cote d'Ivoire" or "Ivory Coast" or Croatia or Cuba or Cyprus or Czechoslovakia or "Czech Republic" or Slovakia or "Slovak Republic"):ti,ab,kw
3 (Djibouti or "French Somaliland" or Dominica or "Dominican Republic" or "East Timor" or "East Timur" or "Timor Leste" or Ecuador or Egypt or "United Arab Republic" or "El Salvador" or Eritrea or Estonia or Ethiopia or Fiji or Gabon or "Gabonese Republic" or Gambia or Gaza or Georgia or Georgian or Ghana or "Gold Coast" or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or "Isle of Man" or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or "Kyrgyz Republic" or Kirghiz or Kirgizstan or "Lao PDR" or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania):ti,ab,kw
4 (Macedonia or Madagascar or "Malagasy Republic" or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or "Marshall Islands" or Mauritania or Mauritius or "Agalega Islands" or Mexico or Micronesia or "Middle East" or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or "Netherlands Antilles" or "New Caledonia" or Nicaragua or Niger or Nigeria or "Northern Mariana Islands" or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or "Puerto Rico"):ti,ab,kw

5 (Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or "Saint Kitts" or "St Kitts" or Nevis or "Saint Lucia" or "St Lucia" or "Saint Vincent" or "St Vincent" or Grenadines or Samoa or "Samoan Islands" or "Navigator Island" or "Navigator Islands" or "Sao Tome" or "Saudi Arabia" or Senegal or Serbia or Montenegro or Seychelles or "Sierra Leone" or Slovenia or "Sri Lanka" or Ceylon or "Solomon Islands" or Somalia or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or "Togolese Republic" or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or "Soviet Union" or "Union of Soviet Socialist Republics" or Uzbekistan or Uzbek or Vanuatu or "New Hebrides" or Venezuela or Vietnam or "Viet Nam" or "West Bank" or Yemen or Yugoslavia or Zambia or Zimbabwe or Rhodesia):ti,ab,kw
6 (developing or less* next developed or "under developed" or underdeveloped or "middle income" or low* next income or underserved or "under served" or deprived or poor*) next (countr* or nation* or population* or world):ti,ab,kw
7 (developing or less* next developed or "under developed" or underdeveloped or "middle income" or low* next income) next (economy or economies):ti,ab,kw
8 low* next (gdp or gnp or "gross domestic" or "gross national"):ti,ab,kw
9 (low near/3 middle near/3 countr*):ti,ab,kw
10 (lmic or lmics or "third world" or "lami country" or "lami countries"):ti,ab,kw
11 ("transitional country" or "transitional countries"):ti,ab,kw
12 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11)
13 diet*
14 MeSH descriptor: [Diet] explode all trees
15 healthy eat*
16 eating behavio*r*
17 MeSH descriptor: [Fruit] explode all trees
18 MeSH descriptor: [Vegetables] explode all trees
19 fruit*
20 vegetable*
21 salt*
22 oil*
23 #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22
24 #12 and #23

Embase

1 (Africa or Asia or Caribbean or West Indies or South America or Latin America or Central America).hw,kf,ti,ab,cp. (204543)
2 (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe).mp. or Rhodesia.hw,kf,ti,ab,cp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (1162890)
3 ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab. (71092)
4 ((developing or less* developed or under developed or underdeveloped or middle income or low* income) adj (economy or economies)).ti,ab. (393)
5 (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. (224)
6 (low adj3 middle adj3 countr*).ti,ab. (6543)
7 (lmic or lmics or third world or lami countr*).ti,ab. (2909)

8 transitional countr*.ti,ab. (167)
9 Developing Countries/ (39887)
10 exp developing countries/ (50210)
11 Clinical trial/ (706431)
12 Randomized controlled trial/ (348366)
13 Randomization/ (61201)
14 Single blind procedure/ (20218)
15 Double blind procedure/ (102427)
16 Crossover procedure/ (41876)
17 Placebo/ (224349)
18 Randomi?ed controlled trial*.tw. (126941)
19 Rct.tw. (19119)
20 Random allocation.tw. (1201)
21 Randomly allocated.tw. (20144)
22 Allocated randomly.tw. (1455)
23 (allocated adj2 random).tw. (318)
24 Single blind*.tw. (13733)
25 Double blind*.tw. (117988)
26 ((treble or triple) adj blind*).tw. (465)
27 Placebo*.tw. (183010)
28 prospective study/ (301913)
29 or/11-28 (1314751)
30 case study/ (33895)
31 Case report.tw. (229806)
32 abstract report/ (437)
33 letter/ (610295)
34 or/30-33 (868262)
35 29 not 34 (1282143)
36 africa/ or "africa south of the sahara"/ or africa, central/ or cameroon/ or central african republic/ or chad/ or congo/ or "democratic republic of the congo"/ or equatorial guinea/ or gabon/ or africa, eastern/ or burundi/ or djibouti/ or eritrea/ or ethiopia/ or kenya/ or rwanda/ or somalia/ or sudan/ or tanzania/ or uganda/ or africa, southern/ or angola/ or botswana/ or lesotho/ or malawi/ or mozambique/ or namibia/ or south africa/ or

swaziland/ or zambia/ or zimbabwe/ or africa, western/ or benin/ or burkina faso/ or cape verde/ or cote d'ivoire/ or gambia/ or ghana/ or guinea/ or guinea-bissau/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or sierra leone/ or togo/ (157854)

37 asia/ or asia, southeastern/ or borneo/ or brunei/ or cambodia/ or east timor/ or indonesia/ or laos/ or malaysia/ or mekong valley/ or myanmar/ or philippines/ or singapore/ or thailand/ or vietnam/ or asia, western/ or bangladesh/ or bhutan/ or india/ or middle east/ or nepal/ or pakistan/ or sri lanka/ or china/ or mongolia/ (337073)
38 exp west indies/ or central america/ or belize/ or costa rica/ or el salvador/ or guatemala/ or honduras/ or nicaragua/ or panama/ or latin america/ (36770)
39 diet*.ti,ab. (381445)
40 diet.sh. (113373)
41 healthy eat*.tw. (4875)
42 eating behavio?r*.tw. (7408)
43 Fruit/ (41651)
44 fruit*.ti,ab. (77202)
45 Vegetables/ (21095)
46 vegetable*.ti,ab. (40948)
47 salt*.ti,ab. (117817)
48 oil*.ti,ab. (113765)
49 1 or 2 or 3 or 4 or 5 or 6 or 7 or 9 or 10 or 36 or 37 or 38 (1319607)
50 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 (679017)
51 35 and 49 and 50 (4955)
52 limit 51 to english language (4620)

Global Health

1 (Africa or Asia or Caribbean or West Indies or South America or Latin America or Central America).hw,kf,ti,ab,cp. (679327)

2 (Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe).mp. or Rhodesia.hw,kf,ti,ab,cp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes] (723669)
3 ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab. (36509)
4 ((developing or less* developed or under developed or underdeveloped or middle income or low* income) adj (economy or economies)).ti,ab. (177)
5 (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. (51)
6 (low adj3 middle adj3 countr*).ti,ab. (3255)
7 (lmic or lmics or third world or lami countr*).ti,ab. (1682)

8 transitional countr*.ti,ab. (81)
9 Developing Countries/ (598721)
10 randomi* control* trial*.ti,ab. (16524)
11 randomized controlled trials/ (22565)
12 controlled clinical trial.ti,ab. (1793)
13 10 or 11 or 12 (31249)
14 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 (817852)
15 diet*.ti,ab. (229852)
16 diet/ (33041)
17 healthy eat*.tw. (3303)
18 eating behavio?r*.tw. (3941)
19 Fruit/ (4239)
20 fruit*.ti,ab. (52456)
21 Vegetables/ (20937)
22 vegetable*.ti,ab. (38882)
23 salt*.ti,ab. (26608)
24 oil*.ti,ab. (63366)
25 or/15-24 (349489)
26 13 and 14 and 25 (995)
27 limit 26 to english language (854)

Web of Science

1 ((Clinical trial*) OR (randomi* control* trial*) OR (random* allocat*) OR placebo* OR (allocat* random*))
2 (diet* OR salt* OR oil* OR vegetable* OR fruit* OR 'eating behavio?r*' OR 'healthy eat*')

3 ((Developing countr*) OR LMIC* OR (Low income countr*) OR (middle income countr*) OR Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or Cape Verde or Central African Republic or Chad or Chile or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaire or Costa Rica or Cote d'Ivoire or Ivory Coast or Croatia or Cuba or Cyprus or Czechoslovakia or Czech Republic or Slovakia or Slovak Republic or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Estonia or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or Isle of Man or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kyrgyz Republic or Kirghiz or Kirgizstan or Lao PDR or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania or Macedonia or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldovia or Moldovian or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or Netherlands Antilles or New Caledonia or Nicaragua or Niger or Nigeria or Northern Mariana Islands or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or Puerto Rico or Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or Saint Kitts or St Kitts or Nevis or Saint Lucia or St Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Saudi Arabia or Senegal or Serbia or Montenegro or Seychelles or Sierra Leone or Slovenia or Sri Lanka or Ceylon or Solomon Islands or Somalia or South Africa or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Togo or Togolese Republic or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or Soviet Union or Union of Soviet Socialist Republics or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Venezuela or Vietnam or Viet Nam or West Bank or Yemen or Yugoslavia or Zambia or Zimbabwe OR Africa or Asia or Caribbean or West Indies or South America or Latin America or Central America))
4 #3 AND #2 AND #1

Medline	
1	Randomized Controlled Trials as Topic/ (103762)
2	randomized controlled trial/ (414801)
3	Random Allocation/ (86656)
4	Double Blind Method/ (135716)

5 Single Blind Method/ (21523)
6 clinical trial/ (507102)
7 clinical trial, phase i.pt. (16082)
8 clinical trial, phase ii.pt. (25785)
9 clinical trial, phase iii.pt. (10932)
10 clinical trial, phase iv.pt. (1095)
11 controlled clinical trial.pt. (91972)
12 randomized controlled trial.pt. (414801)
13 multicenter study.pt. (198098)
14 clinical trial.pt. (507102)
15 exp Clinical Trials as topic/ (303082)
16 or/1-15 (1127258)
17 (clinical adj trial$).tw. (225261)
18 ((singl$ or doubl$ or treb$ or tripl$) adj (blind$3 or mask$3)).tw. (132772)
19 PLACEBOS/ (34061)
20 placebo$.tw. (163816)
21 randomly allocated.tw. (17635)
22 (allocated adj2 random$).tw. (20246)
23 or/17-22 (435692)
24 16 or 23 (1262828)
25 case report.tw. (198085)
26 letter/ (926067)
27 historical article/ (327928)
28 25 or 26 or 27 (1439456)
29 24 not 28 (1228347)
30 diet*.ti,ab. (390702)
31 diet.sh. (119087)
32 healthy eat*.tw. (3145)
33 eating behavio?r*.tw. (5494)
34 Fruit/ (30132)
35 fruit*.ti,ab. (59561)
36 Vegetables/ (18237)

37 vegetables*.ti,ab. (21218)
38 salt*.ti,ab. (126815)
39 oil*.ti,ab. (95180)
40 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 (686385)
41 (((Albania or Algeria or American Samoa or Angola or Azerbaijan or Belarus or Belize or Bosnia) and Herzegovina) or Botswana or Brazil or Bulgaria or China or Colombia or Costa Rica or Cuba or Dominica or Dominican Republic or Ecuador or Fiji or Gabon or Grenada).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (234959)
42 (((Iran or Iraq or Jamaica or Jordan or Kazakhstan or Lebanon or Libya or Macedonia or Malaysia or Maldives or Marshall Islands or Mauritius or Mexico or Mongolia or Montenegro or Namibia or Palau or Panama or Paraguay or Peru or Romania or Serbia or South Africa or St Lucia or St Vincent) and the Grenadines) or Suriname or Thailand or Tonga or Tunisia or Turkey or Turkmenistan or Tuvalu).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (71827)
43 (Africa or Asia or Caribbean or West Indies or South America or Latin America or Central America).hw,kf,ti,ab,cp. (189262)
44 ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab. (58528)
45 ((developing or less* developed or under developed or underdeveloped or middle income or low* income) adj (economy or economies)).ti,ab. (262)
46 (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab. (158)
47 (low adj3 middle adj3 countr*).ti,ab. (4145)
48 (lmic or lmics or third world or lami countr*).ti,ab. (3435)
49 transitional countr*.ti,ab. (111)
50 Developing Countries.sh,kf. (78506)
51 (Afghanistan or Benin or Burkina Faso or Burundi or Cambodia or Central African Republic or Chad or Comoros or Congo or Eritrea or Ethiopia or Gambia).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (37621)
52 (Guinea or Guinea-Bisau or Haiti or Democratic Republic of Korea or Liberia or Madagascar or Malawi or Mali or Mozambique or Nepal or Niger or Rwanda or Sierra Leone or Somalia or South Sudan or Tanzania or Togo or Uganda or Zimbabwe).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (213680)
53 (Armenia or Bangladesh or Bhutan or Bolivia or Cabo Verde or Cameroon or Ivory coast or Djibouti or Egypt or El Salvador or Georgia or Ghana or Guatemala or Guyana or Honduras or India).mp. [mp=title, abstract, original title, name of substance word,

subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (154853)

54 (Indonesia or Kenya or Kiribati or Kosovo or Kyrgyz Republic or Lao or Lesotho or Mauritania or Micronesia or Moldova or Morocco or Myanmar or Nicaragua or Nigeria or Pakistan or Papua New Guinea or Philippines or Samoa).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (89227)
55 (Sao Tome or Senegal or Solomon Islands or Sri Lanka or Sudan or Swaziland or Syria or Tajikistan).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (21665)
56 (Timor-Leste or Ukraine or Uzbekistan or Vanuatu or Vietnam or West Bank or Gaza or Yemen or Zambia).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (37480)
57 africa/ or "africa south of the sahara"/ or africa, central/ or cameroon/ or central african republic/ or chad/ or congo/ or "democratic republic of the congo"/ or equatorial guinea/ or gabon/ or africa, eastern/ or burundi/ or djibouti/ or eritrea/ or ethiopia/ or kenya/ or rwanda/ or somalia/ or sudan/ or tanzania/ or uganda/ or africa, southern/ or angola/ or botswana/ or lesotho/ or malawi/ or mozambique/ or namibia/ or south africa/ or swaziland/ or zambia/ or zimbabwe/ or africa, western/ or benin/ or burkina faso/ or cape verde/ or cote d'ivoire/ or gambia/ or ghana/ or guinea/ or guinea-bissau/ or liberia/ or mali/ or mauritania/ or niger/ or nigeria/ or senegal/ or sierra leone/ or togo/ (178973)
58 asia/ or asia, southeastern/ or borneo/ or brunei/ or cambodia/ or east timor/ or indonesia/ or laos/ or malaysia/ or mekong valley/ or myanmar/ or philippines/ or singapore/ or thailand/ or vietnam/ or asia, western/ or bangladesh/ or bhutan/ or india/ or middle east/ or nepal/ or pakistan/ or sri lanka/ or china/ or mongolia/ (298972)
59 exp west indies/ or central america/ or belize/ or costa rica/ or el salvador/ or guatemala/ or honduras/ or nicaragua/ or panama/ or latin america/ (42515)
60 or/41-59 (1013008)
61 29 and 40 and 60 (3224)
62 limit 61 to humans (2683)
63 limit 62 to english language (2572)

Popline
("Clinical trial*" OR "randomi* control* trial*" OR "random* allocat*" OR placebo* OR "allocat* random*") AND (diet* OR salt* OR oil* OR vegetable* OR fruit* OR "eating behavio?r*" OR "healthy eat*")

Online Supplementary Material, Web Table 2: Characteristics of Included Studies

Study	Setting	Participants	Country	Region	Delivery duration [days] (experimental)	Delivery duration [days] (control)	Population	Pre-existing condition	BCTs (Experimental)	BCTs (Control)
Abujudeh et al. 2012.	Medical	Jordanian adults at high risk of diabetes mellitus	Jordan	Middle East	182.52	1	Individuals (adult)	Yes	1.4, 3.1, 4.1	0
Akhu-Zaheya and Shiyab 2017.	Other	Adult patients with cardiovascular disease	Jordan	Middle East	91.26	91.26	Individuals (adult)	Yes	4.1, 5.1, 7.1	0
Amini et al. 2016	Educational	Overweight/obese primary school children	Iran	Middle East	126	126	Individuals (child)	Yes	4.1, 5.1, 9.1	0
Anetor et al. 2012	Educational	Undergraduates from two of the three first generation universities in south-west Nigeria	Nigeria	Africa	56	56	Individuals (adult)	No	4.1, 5.1	0
Armitage 2014.	Educational	High risk Romanian adolesants	Romania	Europe	1	1	Individuals (child)	No	1.1, 10.7, 10.9	1.4
Bandoni et al. 2011.	Other	Managers and employees	Brazil	South America	182.52	182.52	Individuals (adult)	No	4.1, 7.1, 12.1	0
Bacardí-Gascon et al. 2012.	Educational	Elementary school children	Mexico	South America	56	56	group (family)	Yes	4.1, 12.1	0
Bhurosy and Jeewon 2013.	Medical	Participants were adults (n = 189) aged ≥40 years old from 2 urban community based centres	Mauritius	Africa	182.52	182.52	Individuals (adult)	Yes	1.2, 1.4, 2.3, 4.1, 5.1, 7.1, 8.2	4.1
Cakir and Pinar, 2006.	Medical	persons (N = 320) who had visited the outpatient hypertension clinic between November 2000 and September 2001	Turkey	Europe	182.52	182.52	Individuals (adult)	Yes	1.1, 1.4, 2.3, 2.4, 3.3, 4.1, 9.1, 11.2	0

Cappuccio et al. 2006.	Community	local villagers in a community based cluster trial	Ghana	Africa	182.52	182.52	group (family)	No	4.1, 9.1	0
Cespedes et al. 2013.	Educational	Children	Colombia	South America	152.1	152.1	Other	No	3.2, 4.1	0
Cunha et al. 2013.	Educational	Students average age 11	Brazil	South America	273.78	273.78	Individuals (adult)	No	1.2, 3.2, 4.1, 8.2, 12.1	0
De Villiers et al. 2016	Educational	School children	South Africa	Africa	730	730	Individuals (child)	No	4.1, 9.1	0
Diaz-Ramirez et al. 2016	Educational	School children and their parents	Mexico	South America	182.52	182.52	group (family)	No	3.1, 4.1	0
Duan et al. 2017	Educational	University students	China	Asia	243.36	243.36	Individuals (adult)	No	1.1, 1.4, 2.7, 3.1, 5.1, 6.1, 7.1, 10.6	0
Esfarjani et al. 2013.	Educational	Obese children and their parents	Iran	Middle East	182.52	182.52	group (family)	Yes	1.2, 3.2, 4.1, 12.1	0
Golshahi et al. 2015.	Medical	Hypertensive patients and their families	Iran	Middle East	182.52	182.52	Individuals (adult)	Yes	3.1, 4.1, 9.1	0
Gunawardena et al. 2016	Community	Mothers of school children	Sri Lanka	Asia	365.04	365.04	group (famly)	No	1.2, 2.4, 2.5, 2.7, 4.1, 9.1	0
Habib-Mourad et al. 2014.	Educational	School children	Lebonan	Middle East	91.26	91.26	Individuals (child)	No	1.1, 1.4, 2.3, 3.1, 4.1, 5.1, 5.2, 6.1, 7.1, 8.1, 8.2, 8.6, 12.1, 12.5	0
He et al. 2015.	Educational	Children	China	Asia	106.47	106.47	Individuals (child)	No	1.4, 3.2, 4.1, 5.1, 5.2, 5.3, 8.1, 8.4	0
Hu et al. 2010.	Educational	Children and their parents	China	Asia	365.04	365.04	group (family)	No	4.1, 9.1	0
In-Iw et al. 2012.	Educational	Adolescent girls	Thailand	Asia	121.68	121.68	Individuals (child)	Yes	4.1	0
Jahangiry et al. 2017.	Virtual	Patients with metabolic syndrome	Iran	Middle East	182.52	182.52	Individuals (adult)	Yes	1.2, 2.4, 2.5, 2.6., 2.7, 3.2, 4.1, 7.1, 9.1	4.1
Jaime et al. 2007.	Community	Households	Brazil	South America	21	21	group (family)	No	4.1, 5.1, 6.1, 8.1	0
Jamal et al. 2016	Other	Obese adults in the workplace	Malaysia	Asia	168	168	Individuals (adult)	Yes	1.1, 1.2, 1.4, 1.7, 2.2, 2.3, 2.5, 2.6., 2.7, 3.1, 4.1, 7.1, 9.1, 11.2, 13.1, 15.3	2.3, 4.1

Jemmott III et al. 2011.	Educational	Adolescents	South Africa	Africa	6	6	Individuals (child)	No	3.1, 4.1, 5.1, 8.1	0
Kabahenda et al. 2011.	Community	Less literate, low-income rural female caregivers and the children in their care (6-48 months).	Uganda	Africa	365.04	365.04	group (family)	No	4.1	0
Kain et al. 2014.	Educational	To evaluate the effectiveness of a 12-month multicomponent obesity prevention intervention.	Chile	South America	365.04	365.04	Individuals (child)	Yes	4.1	0
Karavetian et al. 2015.	Medical	hemodialysis patients	Lebonan	Middle East	182.52	182.52	Individuals (adult)	Yes	4.1, 9.1	0
Kreausukon et al. 2012.	Educational	full time undergraduate students	Thailand	Asia	2	2	Individuals (adult)	No	1.1, 1.2, 1.4, 1.6, 6.1, 15.1	0
Leitão 2015.	Medical	Patients With Type 2 Diabetes and Uncontrolled Hypertension	Brazil	South America	28	21	Individuals (adult)	Yes	1.4, 3.1, 4.1, 7.1, 9.1, 12.5	0
Lima et al. 2014.	Medical	patients aged 20 years old and above who were participants of the Program HiperDia were recruited for the study.	Brazil	South America	182.52	182.52	Individuals (adult)	No	1.1, 1.4, 3.1, 4.1, 9.1	0
Lin et al. 2016.	Educational	Children aged 3-6 years and their parents	China	Asia	121.68	121.68	group (family)	No	1.3, 2.3, 3.1, 4.1, 5.1, 8.1, 9.1, 10.3, 12.1, 13.1	0
Martinez-Andrade et al. 2014.	Educational	parent and child were actively engaged in practicing new knowledge during intervention sessions	Mexico	South America	42	42	group (children)	Yes	1.1, 3.1, 4.1, 5.1, 8.1, 9.1	0
Menezes et al. 2015.	Community	women in the Primary Health Care in Brazil	Brazil	South America	182.52	182.52	Individuals (adult)	No	4.1, 5.3, 8.1, 9.2	4.1

Mohd Razif et al. 2013.	Educational	University students	Malaysia	Asia	70	70	Individuals (adult)	No	4.1, 7.1	0
Muchiri et al. 2016.	Community	Adults with Type 2 diabetes	South Africa	Africa	365.04	365.04	Individuals (adult)	Yes	1.1, 1.2, 3.1, 4.1, 5.1, 7.1, 8.1, 8.3, 9.1, 12.1	4.1
Najimi and Ghaffari 2013.	Educational	School children	Iran	Middle East	28	21	Individuals (adult)	No	4.1, 6.1, 8.1	0
Nawi and Jamaludin 2015.	Educational	Adolescents	Malaysia	Asia	84	84	Individuals (child)	Yes	2.4, 2.7, 3.1, 4.1, 5.3	4.1
Nayak and Bhat 2010.	Educational	obese/overweight school children in selected English medium schools of Udupi district, Karnataka	India	Asia	28	28	Individuals (child)	Yes	4.1	0
Nichols et al. 2014.	Educational	Primary school children	Trinidad and Tobago	Caribbean	28	28	Individuals (child)	No	4.1	0
Nourian et al. 2017	Medical	Adolescents with obesity	Iran	Middle East	91.26	91.26	Individuals (child)	Yes	1.2, 3.1, 4.1, 5.1, 7.1, 9.1	0
Ojieabu et al. 2017	Medical	Elderly Type 2 diabetic patients	Nigeria	Africa	121.68	121.68	Individuals (adult)	Yes	3.2, 4.1, 5.1, 9.1	0
Olney et al. 2015.	Community	Mothers of young children	Burkino Faso	Africa	730.08	730.08	group (family)	No	3.1, 3.2, 4.1, 12.5	0
Paes-Barreto et al. 2013.	Medical	Patients With Stages 3 to 5 Chronic Kidney Disease	Brazil	South America	152.1	152.1	Individuals (adult)	Yes	4.1, 5.1, 8.1, 9.1	4.1, 9.1
Pan et al. 1997	Medical	People With Impaired Glucose tolerance	China	Asia	2190.24	2190.24	Individuals (adult)	Yes	1.1, 3.1, 4.1, 9.1	4.1, 9.1
Philippi et al. 2015	Educational	School girls	Brazil	South America	182.52	182.52	Individuals (child)	No	2.3, 4.1, 7.1, 8.2, 9.1, 13.1, 13.2	0
Pichayapinyo et al. 2015.	Medical	population at risk of diabetes	Thailand	Asia	56	56	Individuals (adult)	No	1.1, 1.2, 1.4, 1.5, 2.3, 3.1, 4.1, 6.1	4.1
Pimentel et al. 2010.	Medical	Brazilians with impaired glucose tolerance	Brazil	South America	365.04	9	Individuals (adult)	Yes	4.1, 9.1	0
Quizan-Plata et al. 2012.	Educational	Children from official primary schools open during the day	Mexico	South America	273.78	273.78	Individuals (child)	Yes	4.1, 6.1, 8.1	0

Ram et al. 2014.	Community	Asian indian men	India	Asia	730.08	730.08	Individuals (adult)	Yes	4.1, 7.1	4.1
Rausch Herscovici, et al. 2013.	Educational	Primary school children (and their parents but outcome measures only taken for children)	Argentina	South America	182.52	182.52	group (family)	No	4.1, 5.1, 12.1	0
Rerksuppaphol and Rerksuppaphol 2017	Educational	School children	Thailand	Asia	121.68	121.68	Individuals (child)	No	2.2, 2.4, 2.6, 4.1, 9.1	2.3, 2.6, 4.1
Ribeiro et al. 2011.	Community	Adult women	Brazil	South America	152.1	152.1	Individuals (adult)	Yes	1.1, 3.1, 4.1, 5.1, 6.1	4.1, 5.3
Safdie et al. 2013.	Educational	4th and 5th grade students	Mexico	South America	547.56	547.56	Individuals (child)	No	3.1, 4.1, 12.1, 12.3	0
Salehi et al. 2011.	Community	Elderly iranians	Iran	Middle East	21	21	Individuals (adult)	Yes	1.1, 3.1, 5.1, 5.1, 5.3, 10.3, 10.9	0
Saneei et al. 2013.	Community	Post-pubescent adolescent girls	Iran	Middle East	42	42	Individuals (child)	Yes	1.1, 1.4, 2.3, 3.1, 4.1, 5.3, 9.1	0
Saraf et al. 2015.	Educational	Middle School Children	India	Asia	243.36	243.36	Individuals (child)	No	4.1	0
Sarrafzadegan et al. 2009.	Community	community residents	Iran	Middle East	1460.16	1095.12	Individuals (adult)	No	3.1, 4.1	0
Sartorelli et al. 2005.	Medical	Brazilian adults	Brazil	South America	182.52	182.52	Individuals (adult)	Yes	1.1, 1.4, 4.1, 5.3	0
Schreinemachers et al. 2017a	Educational	School children	Bhutan	Asia	365.04	365.04	Individuals (child)	No	1.8, 3.2, 4.1, 5.1, 7.7, 8.1, 9.1, 12.1, 12.5	0
Schreinemachers et al. 2017b	Educational	School children	Nepal	Asia	730.1	730.1	Individuals (child)	No	3.2, 4.1, 5.1, 6.1, 7.1, 7.7, 8.1, 9.1, 12.1, 12.5	0
Shahid et al. (2015)	Medical	Diabetes patients in rural areas	Pakistan	Asia	121.68	121.68	Individuals (adult)	Yes	2.4, 2.6, 9.1	4.1
Shamah Levy et al. 2012.	Educational	Mexican school children	Mexico	South America	182.52	182.52	Individuals (child)	No	2.1, 4.1, 7.1, 9.1, 12.1	0
Shojaei et al. 2016	Medical	Patients who have had heart bypass surgery	Iran	Middle East	30.42	30.42	Individuals (adult)	Yes	3.1, 4.1, 9.1	0
Tamban et al. 2013.	Medical	Subjects with diabeties mellitus	Philippines	Asia	182.52	182.52	Individuals (adult)	Yes	4.1, 5.1, 7.1	0
Tan et al. 2011.	Educational	patients with poorly controlled diabetes	Malaysia	Asia	84	84	Individuals (adult)	Yes	3.1, 6.1	0

Toral and Slater 2012.	Educational	Adolescents	Brazil	South America	182.52	182.52	Individuals (child)	No	1.2, 4.1, 5.1, 10.3	4.1
Toulabi et al. 2012.	Educational	Adolescents	Iran	Middle East	730.08	730.08	Individuals (child)	Yes	2.3, 4.1, 9.1	0
Van Rooijen et al. 2010.	Medical	Individuals with Type 2 Diabetes Mellitus	South Africa	Africa	112	112	Individuals (adult)	Yes	3.1, 4.1, 7.1	0
Wafa et al. 2011.	Community	obese children	Malaysia	Asia	182.52	182.52	Individuals (adult)	Yes	1.8, 2.3, 2.7, 3.1, 4.1, 8.1, 10.3, 10.6	0
Wang et al. 2015.	Educational	Adolescents	China	Asia	182.52	182.52	Individuals (child)	No	1.1, 3.1, 4.1	0
Wei et al. 2017	Medical	Patients at risk of cardiovascular disease in rural China	China	Asia	365.04	365.04	Individuals (adult)	Yes	3.1, 4.1, 7.1, 9.1	0
Wong et al. 2013.	Community	People with non-alcoholic fatty liver disease	China	Asia	365.04	365.04	Individuals (adult)	Yes	4.1, 9.1	0
Xavier et al. 2016	Medical	Patients with acute coronary syndrome	India	Asia	365.04	365.04	Individuals (adult)	Yes	1.2, 1.4, 2.3, 2.7, 3.1, 4.1, 5.1, 7.1, 9.1	0
Zhou et al. 2010.	Community	Older Rural chinese population	China	Asia	273.78	273.78	Individuals (adult)	No	3.1, 4.1, 9.1	0

1.1= Goal setting (behaviour), 1.2 = Problem solving, 1.3 = Goal setting (outcome), 1.4 = Action planning, 1.5 = Review behaviour goal(s), Discrepancy between current behaviour and goal, 1.7 = Review outcome goal(s), 2.1 = Monitoring of behaviour by others without feedback, 2.3 = Self-monitoring of behaviour, 2.4 = Self-monitoring of outcome(s) of behaviour, 2.7 = Feedback on outcome(s) of behaviour, 3.1 = Social support (unspecified), 3.2 = Social support (practical), 3.3 = Social support (emotional), 4.1 = Instruction on how to perform the behaviour, 5.1. Information about health consequences, 5.2 = Salience of consequences, 5.3 = Information about social and environmental consequences, 6.1 = Demonstration of the behaviour, 7.1 = Prompts/cues, 8.1 = Behavioural practice/rehearsal, 8.2 = Behaviour substitution, 8.4 = Habit reversal, 8.6 = Generalisation of target behaviour, 9.1 = Credible source, 9.2 = Pros and cons, 10.3 = Non-specific reward, 10.6 = Non-specific incentive, 10.9 = Self-reward, 11.2 = Reduce negative emotions, 12.1 = Restructuring the physical environment, 12.5 = Adding objects to the environment, 15.1 = Verbal persuasion about capability

Online Supplementary Material, Web Table 3: PRISMA checklist

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

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5-6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	6
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	6-7

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6-8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Web Table 2 & submitted data-file
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	8, Table 2 & submitted data-file
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Figure 2 & submitted data-file

Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	8-10, 12
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	8 & Table 2
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	9-11 Table 1 & 2
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	12-15
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	13-15
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13-15
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	-

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

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