Review

Association between fruit and vegetable consumption and depression symptoms in young people and adults aged 15-45: A systematic review of cohort studies

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**Supplementary Table 1.** Inclusion and exclusion criteria for study designs

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|  | **Inclusion**  | **Exclusion**  |
| **Population** | People 15-45 years of ageHealthy population  | Presence of chronic disease including depressionAdults with nutritional needs different from the general populationUnique populations which are less likely to be representative of the general population (e.g., monks) Animal studies  |
| **Study Design** | Original cohort studies with a minimum follow up time of 12 months or longer  | Cross sectional studiesRandomised control trialsCase-control studiesReviewsReportsNon-empirical research  |
| **Time Frame** | 1 January 2000 to 31 August 2020 | Prior to 2000  |
| **Exposure** | Fruit and vegetable consumption, both independently and/or together | Fruit and vegetables were not analysed separately from other dietary patterns  |
| **Outcome**  | Depressive symptoms or Depression measured using validated questions, QoL, doctors diagnosis or medication use for depression | No valid measure of depressive symptoms/depression  |

**Supplementary Table 2.** Full electronic search strategy applied for Medline, Embase, and PsycInfo

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| **Database** | **The applied full electronic search strategy** |
| Medline via Ovid | 1. Young Adult/2. Adolescent/ or Adult/3. (young people or young adult\* or early adult\* or emerging adult\* or adult\*).ti,ab.4. 1 or 2 or 35. exp Fruit/ or "Fruit and Vegetable Juices"/6. Malus/ or Citrus sinensis/ or Pyrus/ or Vitis/ or Musa/ or exp Citrus/ or Rubus/ or Psidium/ or Actinidia/7. exp Vaccinium/ or Carica/ or cucurbitaceae/ or citrullus/ or Ananas/ or Fragaria/ or Carotenoids/ or exp Prunus/8. Rheum/ or Bombacaceae/ or Cocos/ or Citrullus/9. (fruit\* or apple\* or orange\* or pear or pears or grape or grapes or banana\* or berry or berries or citrus).ti,ab.10. (blackberr\* or cranberr\* or guava\* or kiwi\* or lingonberr\* or papaya\* or mandarin\* or tangerine\* or melon\* or pineapple\*).ti,ab.11. (raspberr\* or strawberr\* or grapefruit\* or satsuma\* or plum or plums or apricot\* or peach or peaches or rhubarb or durian or cherry or cherries).ti,ab.12. (nectarine\* or coconut\* or dragonfruit\* or watermelon\*).ti,ab.13. (fruit adj1 (intake\* or consumption\*)).ti,ab.14. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 1315. Vegetables/ or vegetarians/ or vegans/ or Plant Leaves/16. Daucus carota/ or Lycopersicon esculentum/ or Solanum tuberosum/ or exp allium/ or onions/17. Apium/ or Spinacia oleracea/ or peas/ or soybeans/ or Phaseolus/ or Fabaceae/ or exp Chenopodiaceae/ or exp Brassica/18. Cucumis sativus/ or Salads/ or Solanum melongena/ or Capsicum/ or Abelmoschus/ or Cucurbita/19. Cynara scolymus/ or Lettuce/ or Pastinaca/ or Asparagus Plant/ or Cicer/ or Foeniculum/ or seaweed/ or kelp/20. Ipomoea batatas/ or Agaricales/ or Nuts/ or Soy Foods/ or "Fermented Foods and Beverages"/21. (vegetable\* or vegan\* or vegetarian\* or leafy green\* or carrot\* or cabbage\* or brassica\* or tomato or tomatoes or potato or potatoes).ti,ab.22. (onion\* or celery or spinach or pea or peas or bean or beans or broccoli or cauliflower\* or beetroot\* or turnip\* or cucumber).ti,ab. |
| **Database** | **The applied full electronic search strategy** |
| Medline via Ovid | 24. (kale or parsnip\* or asparagus or chickpea\* or fennel or seaweed\* or sweet potato\* or kimchi or mushroom\* or tofu or tempeh).ti,ab.25. (vegetable adj1 (intake\* or consumption\*)).ti,ab.26. 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 2527. diet/ or diet, mediterranean/ or diet, vegetarian/ or diet, vegan/ or diet, western/ or diet, healthy/28. Dietary Fiber/ or Antioxidants/ or Nutritional Status/ or Folic Acid/ or Micronutrients/ or Nutrition Surveys/ or Nutrition Assessment/ or "diet, food, and nutrition"/29. (diet\* or healthy diet or nutrition\* or juice\*).ti,ab.30. ((fruit and vegetable) adj1 (intake or consumption)).ti,ab.31. 27 or 28 or 29 or 3032. 14 or 26 or 3133. affective symptoms/ or depression/ or mental fatigue/ or mental disorders/ or anxiety disorders/ or mood disorders/34. Depressive Disorder, Major/ or Depressive Disorder/ or Dysthymic Disorder/ or Seasonal Affective Disorder/35. Panic Disorder/ or Panic/ or self mutilation/ or exp suicide/ or exp stress, psychological/ or fear/ or frustration/ or loneliness/ or sadness/36. (depression or depressive or anxiety or anxious or psychological distress or worries or sad or unhappy or unhappiness or helpless\* or hopeless\*).ti,ab.37. (suicide\* adj2 (thought\* or idea\* or think\* or attempt\*)).ti,ab.38. (self adj1 (injury or harm or hurt)).ti,ab.39. healthy lifestyle/ or Life Change Events/ or Mental Health/ or affect/ or irritable mood/ or anxiety/40. (automutilation or alienation or lonely or depressed or well-being or well being).ti,ab.41. 33 or 34 or 35 or 36 or 37 or 38 or 39 or 4042. epidemiologic studies/ or exp cohort studies/43. (cohort stud\* or cohort analysis).ti,ab.44. (follow up adj1 (study or studies)).ti,ab.45. (longitudinal adj1 (study or studies)).ti,ab.46. 42 or 43 or 44 or 4547. 4 and 32 and 41 and 4648. limit 47 to (english language and humans and yr="2000 - 2020") |
| **Database** | **The applied full electronic search strategy** |
| Embase via Ovid | 1. young adult/ or adult/ or adolescent/2. (young people or young adult\* or early adult\* or emerging adult\* or adult\*).ti,ab.3. adolescence/ or adulthood/4. 1 or 2 or 35. fruit juice/ or fruit consumption/ or fruit vegetable/ or exp fruit/6. apple juice/ or apple/ or sweet orange/ or orange juice/7. durian fruit/ or passion fruit/ or "lime (fruit)"/ or "orange (fruit)"/ or Evodia fruit/ or "date (fruit)"/ or pome fruit/ or citrus fruit/ or miracle fruit/8. pear juice/ or pear/ or grape juice/ or grape/ or banana/ or berry juice/ or berry/9. citrus/ or grapefruit/ or lemon/ or mandarin/ or satsuma/ or tangerine/ or guava/ or blackberry/ or cranberry juice/ or cranberry/ or guava/10. avocado/ or berry/ or black currant/ or blueberry/ or breadfruit/ or gooseberry/ or huckleberry/ or kiwifruit/ or lingonberry/ or loquat/ or lychee/ or mango/ or miracle fruit/ or muskmelon/ or papaya/ or passion fruit/ or persimmon/ or pineapple/ or pome fruit/ or pomegranate/ or raspberry/ or strawberry/ or tomato/ or watermelon/11. mango juice/ or lime juice/ or beetroot juice/ or watermelon juice/ or plant juice/ or lemon juice/ or apple juice/ or cherry juice/ or aloe juice/ or mandarin juice/ or tomato juice/ or pineapple juice/12. strawberry juice/ or grapefruit/ or grapefruit juice/ or plum/ or apricot/ or peach/ or rhubarb/ or nectarine/ or coconut/ or Hylocereus undatus/13. (fruit\* or apple\* or orange\* or pear or pears or grape or grapes or banana\* or berry or berries or citrus).ti,ab.14. (blackberr\* or cranberr\* or guava\* or kiwi\* or lingonberr\* or papaya\* or mandarin\* or tangerine\* or melon\* or pineapple\*).ti,ab.15. (raspberr\* or strawberr\* or grapefruit\* or satsuma\* or plum or plums or apricot\* or peach or peaches or rhubarb or durian or cherry or cherries).ti,ab.16. (nectarine\* or coconut\* or dragonfruit\* or watermelon\*).ti,ab.17. (fruit adj1 (intake\* or consumption\*)).ti,ab.18. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 1719. vegetable/ or "root vegetable"/ or pickled vegetable/ or leafy vegetable/ or stem vegetable/ or vegetable consumption/ or vegetable juice/20. vegan diet/ or vegan/ or vegetarian diet/ or vegetarian/ or fermented soybean/ or tofu/ or kimchi/21. carrot juice/ or carrot/ or Chinese cabbage/ or celery cabbage/ or cabbage/ or white cabbage/ or red cabbage/ or Brassica/ or potato/ or sweet potato/ or onion/ or celery/ |
| **Database** | **The applied full electronic search strategy** |
| **Embase via Ovid**  | 22. spinach/ or pea/ or bean/ or legume/ or soybean/ or broccoli/ or cauliflower/ or beetroot juice/ or beetroot/ or turnip/ or cucumber/ or salad/ or leek/ or aubergine/23. Romaine lettuce/ or lettuce/ or leaf lettuce/ or iceberg lettuce/ or kale/ or Chinese kale/ or parsnip/ or asparagus/ or chickpea/ or fennel/24. seaweed/ or edible mushroom/ or pepper/ or okra/ or squash/ or artichoke/25. (vegetable\* or vegan\* or vegetarian\* or leafy green\* or carrot\* or cabbage\* or brassica\* or tomato or tomatoes or potato or potatoes).ti,ab.26. (onion\* or celery or spinach or pea or peas or bean or beans or broccoli or cauliflower\* or beetroot\* or turnip\* or cucumber).ti,ab.27. (salad or salads or legume\* or leek or leeks or aubergine\* or pepper\* or okra or pumpkin\* or squash\* or artichoke\* or lettuce\*).ti,ab.28. (kale or parsnip\* or asparagus or chickpea\* or fennel or seaweed\* or sweet potato\* or kimchi or mushroom\* or tofu or tempeh).ti,ab.29. (vegetable adj1 (intake\* or consumption\*)).ti,ab.30. 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 2931. diet/ or high fiber diet/ or mediterranean diet/ or western diet/32. exp healthy diet/ or nutrient/ or nutrient intake/ or trace element/ or antioxidant/ or folic acid/ or dietary fiber/ or fruit vegetable/33. nutrition/ or adolescent nutrition/ or dietary intake/ or dietary pattern/ or food intake/ or nutritional assessment/34. (fruit and vegetable).ti,ab.35. (diet\* or healthy diet or nutrition\* or juice\*).ti,ab.36. ((fruit and vegetable) adj1 (intake or consumption)).ti,ab37. 31 or 32 or 33 or 34 or 35 or 3638. 18 or 30 or 3739. depression inventory/ or minor depression/ or Self-rating Depression Scale/ or "mixed anxiety and depression"/ or major depression/ or depression/ or adolescent depression/ or depression assessment/ or mental health/40. depression/ or seasonal affective disorder/ or dysthymia/ or panic/ or mental disease/ or anxiety disorder/ or emotional disorder/ or mood disorder/41. suicidal behavior/ or suicidal ideation/ or suicide/ or suicide attempt/ or automutilation/ or frustration/ or loneliness/ or sadness/ |
| **Database** | **The applied full electronic search strategy** |
| **Embase via Ovid** | 42. emotion/ or affect/ or anger/ or fear/ or helplessness/ or hopelessness/ or mood/ or mood change/ or nervousness/ or unhappiness/43. (depression or depressive or anxiety or anxious or psychological distress or worries or sad or unhappy or unhappiness or helpless\* or hopeless\*).ti,ab.44. (symptom\* of depression or depressive symptom\*).ti,ab.45. (suicide\* adj2 (thought\* or idea\* or think\* or attempt\*)).ti,ab.46. (self adj1 (injury or harm or hurt)).ti,ab.47. healthy lifestyle/48. life event/49. ("loss of interest" or alienation or lonely or depressed or well-being or well being).ti,ab.50. 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 4951. epidemiology/ or cohort analysis/ or longitudinal study/ or follow up/52. (cohort stud\* or cohort analysis).ti,ab.53. (follow up adj1 (study or studies)).ti,ab.54. (longitudinal adj1 (study or studies)).ti,ab.55. 51 or 52 or 53 or 5456. 4 and 38 and 50 and 5557. limit 56 to (human and english language and yr="2000 -2020") |
| PsycInfo via Ovid | 1. Adult Offspring/2. (young people or young adult\* or early adult\* or emerging adult\* or adult\*).ti,ab.3. Emerging Adulthood/4. 1 or 2 or 35. Diets/ or Food Intake/ or Food Preferences/ or Nutrition/6. (fruit\* or apple\* or orange\* or pear or pears or grape or grapes or banana\* or berry or berries or citrus).ti,ab.7. (blackberr\* or cranberr\* or guava\* or kiwi\* or lingonberr\* or papaya\* or mandarin\* or tangerine\* or melon\* or pineapple\*).ti,ab.8. (raspberr\* or strawberr\* or grapefruit\* or satsuma\* or plum or plums or apricot\* or peach or peaches or rhubarb or durian or cherry or cherries).ti,ab.9. (nectarine\* or coconut\* or dragonfruit\* or watermelon\*).ti,ab. |
| **Database** | **The applied full electronic search strategy** |
| PsycInfo via Ovid | 10. (fruit adj1 (juice\* or consumption or intake)).ti,ab.11. (vegetable\* or vegan\* or vegetarian\* or leafy green\* or carrot\* or cabbage\* or brassica\* or tomato or tomatoes or potato or potatoes).ti,ab.12. (onion\* or celery or spinach or pea or peas or bean or beans or broccoli or cauliflower\* or beetroot\* or turnip\* or cucumber).ti,ab.13. (salad or salads or legume\* or leek or leeks or aubergine\* or pepper\* or okra or pumpkin\* or squash\* or artichoke\* or lettuce\*).ti,ab.14. (kale or parsnip\* or asparagus or chickpea\* or fennel or seaweed\* or sweet potato\* or kimchi or mushroom\* or tofu or tempeh).ti,ab.15. "fruit and vegetable".ti,ab.16. (vegetable adj1 (juice\* or consumption or intake)).ti,ab.17. Folic Acid/18. Antioxidants/19. (nutritional adj1 (assessment\* or survey\*)).ti,ab.20. (mediterranean diet or healthy diet or dietary pattern\* or dietary intake).ti,ab.21. ((fruit and vegetable) adj1 (intake or consumption)).ti,ab.22. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 2123. major depression/ or affective disorders/ or dysthymic disorder/ or seasonal affective disorder/24. Adolescent Development/ or Anxiety Disorders/ or "Depression (Emotion)"/25. mental health/ or mental status/ or "mental health and illness assessment"/ or well being/26. mental disorders/ or psychological assessment/ or suicide/27. negative emotions/ or fatigue/ or Life Changes/ or Stress/ or psychological stress/28. emotional states/ or alienation/ or anxiety/ or distress/ or fear/ or frustration/ or hopelessness/ or loneliness/ or pessimism/ or restlessness/ or sadness/ or suffering/29. (depression or depressive or anxiety or anxious or psychological distress or worries or sad or unhappy or unhappiness or helpless\* or hopeless\*).ti,ab.30. ("symptom\* of depression" or "depressive symptom\*").ti,ab.31. (suicide\* adj2 (thought\* or idea\* or think\* or attempt\*)).ti,ab.32. (self adj1 (injury or harm or hurt)).ti,ab.33. ("loss of interest" or alienation or lonely or depressed or well-being or well being).ti,ab. |
| **Database** | **The applied full electronic search strategy** |
| **PsycInfo via Ovid** | 34. 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 3335. cohort analysis/ or longitudinal studies/ or prospective studies/ or followup studies/ or epidemiology/36. (cohort stud\* or cohort analysis).ti,ab.37. (follow up adj1 (study or studies)).ti,ab.38. (longitudinal adj1 (study or studies)).ti,ab.39. 35 or 36 or 37 or 3840. 4 and 22 and 34 and 3941. limit 40 to (english language and yr="2000 -2020") |

**Supplementary Table 3.**Justification of exclusion at full text screening

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| **Reason for exclusion** | **Number of studies** | **Excluded studies reference** |
| Incorrect study design: Cross sectional Case-controlRandomised control trialPoster formatShort time follow-upAbstract only available  | n= 64 | Godos J, et al., 2019Emerson SD, et al., 2019Schiltchen D, et al., 2019Abildsnes E, et al. 2017Adjibade M, et al. 2017Wirth M, et al. 2016Herbison CE, et al. 2012Szabo de Edelenyi F, et al., 2020Moreno-Agostino D, et al., 2019Sánchez-Villegas A, et al. 2009Esteban-Fonzalo L, et al., 2019Gibson-Smith D, et al., 2018Sangsefidi ZS, et al., 2020Wesselman LMP, et al., 2019Matta J, Hoertel N, et al., 2020Gascoyne CR, et al., 2019 | Saghafian F, et al., 2019Paans NPG, et al., 2019Moludi J, et al., 2020Matta J, et al., 2018Solmi M, et al., 2019Paslakis G, et al., 2020Miyake Y, et al., 2018Hajianfar H, et al., 2020Alfawas W, et al., 2019Bryan J,et al. 2004Richard A, et al. 2015Won MS,et al. 2016Ashurst J, et al. 2016Ackard DM, et al. 2002Konttinen H, et al. 2010Gregorio MJ, et al. 2017 | Matta J, et al., 2019Pfeiler TM, et al., 2020Sousa KT, et al., 2019Philips A, et al., 2020Lee J, et al., 2020Wu H, et al., 2020Ju SY, et al., 2019Sangsefidi ZS, et al., 2020Sakai H, et al. 2017Miki T, et al. 2015Beydoun MA, et al 2010Watanabe H, et al 2012Ahmed N, et al. 2017Beydoun MA, et al. 2010Yary T. et al. 2013Bergmans RS, et al. 2017 | Liu C, et al. 2007Watanabe H, et al. 2011Adams TB, et al. 2008Shakya PR, et al., 2020Grases G, et al., 2019Avalos LA, et al., 2020Ashurst J, et al., 2018Liao Y, et al., 2019Shakya PR, et al., 2020Shin Y, et al., 2019Wu S, et al., 2018Patel S, et al., 2019Nanri A, et al. 2010Fabian C, et al. 2013Bertram L, et al. 2014Wirth MD, et al. 2017 |
| Incorrect populationStarted with depressionHad existing medical issuesAge only >45 years old Age only < 14 years oldMost participants in population is older peopleUnique population  | n= 26 | Ramin S, et al., 2020Nathanson R, et al., 2018Pengpid S, et al., 2019Elstgeest LEM, et al., 2019Cherian L, et al., 2020Sanchez-Villegas A, et al. 2006Sanchez-Villegas A, et al. 2017 | Youri J et al 2016Notara V, et al. 2016Tolmunen T, et al. 2004Walsh JL, et al. 2013Hingle MD, et al. 2014Adjibade M, et al. 2017Baek D, et al. 2013 | Huang P, et al., 2019Loewen OK, et al., 2019Boehm JK, et al., 2018Kobayashi LC, et al., 2018Lavalee K, et al., 2019Matthews KA, et al., 2019 | Nanri A, et al. 2013Ruusunen A, et al. 2014Ribeiro SML, et al. 2017Lai JS, et al. 2017Cheng HY, et al., 2019Hoare E et al., 2020 |
| **Reason for exclusion** | **Number of studies** | **Excluded studies reference** |
| Incorrect intervention/exposureFruit and vegetables not analysed separate from diet Only looking at specific nutrients  | n= 35 | Adjibade M, et al., 2019Adjibabe M, Lemogne C, et al., 2019Adjibabe M, Lemogne C, Julia C, et al., 2019Sanchez-Villegas A, Ruiz-Canela M, et al. 2015Sharpe PA, et al. 2016Northstone K, et al. 2018Smith-Marek EN et al. 2016Vermeulen E, et al. 2016 | Opie RS, et al., 2020Recchia D, et al., 2020Nanri A, et al., 2020Marozoff S, et al., 2020Oftedal S, et al., 2020Schweren LJS, et al., 2020Oddy WH, et al., 2018Carlos S, et al., 2018Northstone K, et al., 2020Guo F, et al., 2019Sanchez-Villegas A et al. 2015 | Fresan U, et al., 2019Wilson CA, et al., 2020Velten J, et al., 2018Riuz-Estigarribia L, et al., 2019Miki T, et al., 2018Derom ML, et al. 2012Kesse-Guyot E, et al. 2013Nanri A, et al. 2013Pisinger C, et al. 2016 | Henriquez Sanchez P 2012Beydoun MA, et al. 2016Kurspahic-Mujcic A, et al. 2014Astorg P, et al. 2008Gall SL, et al. 2016Mouchacca J, et al. 2013Akbaraly T, et al. 2016 |
| Incorrect outcome Looked at key life transitionsLooked at cognitive functioningLooked at happiness as an outcome  | n= 7 | Winpenny EM, et al., 2018Kesse-Guyot E, et al. 2014 | Mujcic R, et al. 2016Haibach JP, et al 2016 | Allen MS, et al. 2016Kim O, et al. 2017 | Haibach JP, et al. 2015 |

**Supplementary Table 4.** The Newcastle-Ottawa Scale results

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| **Author** | **Selection\*** | **Comparability‡** | **Outcome†** | **Total§** |
| **Representativeness of the exposed cohort**  | **Selection of the non-exposed cohort** | **Ascertainment of exposure** | **Demonstration that outcome of interest was not present at start of study** | **Adjust for** **the most important risk factors**  | **Adjust for other risk factors** | **Assessment of outcome** | **Follow-up adequacy** | **Adequacy of follow up of cohorts** |
| Choda et al., 2020 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 7Good |
| Mujcic and Oswald, 2019 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 7Good |
| Ocean et al., 2019 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6Good |
| Winzer et al., 2018 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 6Good |
| Winpenny et al., 2018 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 6Good |
| Hoare et al., 2018 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 6Good |
| Chang et al., 2016  | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 6Good |
| Collin et al., 2016 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 5Moderate |
| Kingsbury et al., 2016 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 8Very Good |
| Akbaraly et al., 2013  | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 6Good |
| Chai et al., 2010 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 4Moderate |
| Sanchez-Villegas et al., 2009 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 6Good |

\*Maximum 4 points awarded for cohort representativeness, selection of non-exposed cohort, exposure assessment and demonstration outcome not present at baseline.

‡Maximum 2 points awarding for controlling for the primary confounding variable and the secondary confounding variables.

†Maximum 3 points awarded for follow-up length, adequacy of follow-up and outcome assessment.

§A maximum of 9 points could be awarded.

Category:

Very Good quality = 8-9 points; Good quality = 6-7 points; Moderate quality = 4-5 points; Low quality = 0-3 points

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