Supplementary material

Supplementary Table 1. PRISMA 2020 Checklist: effect of virtual reality rehabilitation on motor function and activities of daily living in stroke patients: a systematic review and meta-analysis.

| **Section and Topic**  | **Item#** | **Checklist item** | **Location where item is reported**  |
| --- | --- | --- | --- |
| **TITLE** |  |
| Title | 1 | Identify the report as a systematic review. | 2 |
| **ABSTRACT** |  |
| Abstract | 2 | See the PRISMA 2020 for Abstracts checklist. | 2 |
| **INTRODUCTION** |  |
| Rationale | 3 | Describe the rationale for the review in the context of existing knowledge. | 2–3 |
| Objectives | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | 3 |
| **METHODS** |  |
| Eligibility criteria | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | 4 |
| Information sources | 6 | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | 4–5 |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | 5 |
| Selection process | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | 5 |
| Data collection process | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | 5 |
| Data items | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (*e.g.*, for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | 6 |
| 10b | List and define all other variables for which data were sought (*e.g.*, participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | 6 |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | 7–8 |
| Effect measures | 12 | Specify for each outcome the effect measure(s) (*e.g.*, risk ratio, mean difference) used in the synthesis or presentation of results. | 8 |
| Synthesis methods | 13a | Describe the processes used to decide which studies were eligible for each synthesis (*e.g.*, tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | 7 |
| 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | 4–5 |
| 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | 5–6 |
| 13d | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | 4 |
| 13e | Describe any methods used to explore possible causes of heterogeneity among study results (*e.g.*, subgroup analysis, meta-regression). | 9–10 |
| 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | 9–10 |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | 10 |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | 10 |
| **RESULTS** |  |
| Study selection | 16a | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram. | 5–6 |
| 16b | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | 5 |
| Study characteristics | 17 | Cite each included study and present its characteristics. | 5–6 |
| Risk of bias in studies | 18 | Present assessments of risk of bias for each included study. | 8–10 |
| Results of individual studies | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (*e.g.*, confidence/credible interval), ideally using structured tables or plots. | 9–11 |
| Results of syntheses | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | 11 |
| 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (*e.g.*, confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | 9–11 |
| 20c | Present results of all investigations of possible causes of heterogeneity among study results. | 10–11 |
| 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | 10 |
| Reporting biases | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | not |
| Certainty of evidence | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | 9–10 |
| **DISCUSSION** |  |
| Discussion | 23a | Provide a general interpretation of the results in the context of other evidence. | 11–13 |
| 23b | Discuss any limitations of the evidence included in the review. | 13 |
| 23c | Discuss any limitations of the review processes used. | 13 |
| 23d | Discuss implications of the results for practice, policy, and future research. | 13 |
| **OTHER INFORMATION** |  |
| Registration and protocol | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | 3 |
| 24b | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | 3 |
| 24c | Describe and explain any amendments to information provided at registration or in the protocol. | 3 |
| Support | 25 | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | not |
| Competing interests | 26 | Declare any competing interests of review authors. | 14 |
| Availability of data, code and other materials | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | 14 |

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Supplementary Table 2. Systematic literature review search terms and strategy.

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| Search terms for PubMed |
| #1 (Exercises) AND (Physical Activity) AND (Activities, Physical) AND (Exercise, Physical) AND (Physical Exercise) AND (Acute Exercise) AND (Exercise, Isometric) AND (Isometric Exercise) AND (Aerobic Exercise) AND (Exercise Training) AND (Training, Exercise) |
| #2 (Dysfunction, Erectile) AND (Male Impotence) AND (Impotence, Male) AND (Male Sexual Impotence) AND (Impotence, Male Sexual) AND (Sexual Impotence, Male) AND (Impotence) AND (vascular erectile dysfunction) |
| #3 “Exercise” (MeSH Major Topic) AND “Erectile Dysfunction” (MeSH Major Topic) |
| #1 AND #2 AND #3 |
| Search terms for Web of science |
| ((TS = (exercise) OR TS = (physical exercise) OR TS = (training) OR TS = (physical activity) OR TS = (aerobic exercise) OR TS = (brisk walking) OR TS = (jogging) OR TS = (cycling) OR TS = (swimming) OR TS = (Aerobic, on bicycle ergometer) OR TS = (Gym exercises)) AND (TS = (erectile dysfunction) OR TS = (vascular erectile dysfunction)) |

Notes: MeSH, Medical Subject Headings; TS, Topic.

Supplementary Table 3. Studies included in systematic reviews or Meta-analyses assessing the impact of PE on ED.

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| --- | --- |
| Studies | Systematic reviews or meta-Analyses |
|  | Gerbild *et al.* [4], 2018 | Lamina *et al.* [32], 2011 | Silva *et al.* [22], 2016 | Khera *et al.* [33], 2023 |
| Esposito *et al.* [27], 2004 |  | Y | Y | Y |
| Kałka *et al.* [39], 2009 |  | Y |  |  |
| Kalka *et al.* [25], 2013 | Y |  | Y | Y |
| Khoo *et al.* [62], 2013 | Y |  |  |  |
| Lamina *et al.* [19], 2009 | Y | Y | Y | Y |
| Maio *et al.* [38], 2010 | Y | Y | Y | Y |
| Maresca *et al.* [44], 2013 | Y |  | Y | Y |
| Vignera *et al.* [30], 2011 | Y |  |  |  |
| Lin *et al.* [42], 2012 |  |  | Y |  |
| Dorey *et al.* [24], 2004 |  |  | Y |  |
| Lamina *et al.* [19], 2009 |  | Y |  |  |
| Kalka *et al.* [40], 2015 | Y |  |  |  |
| Kalka *et al.* [66], 2016 | Y |  |  |  |
| Begot *et al.* [41], 2015 | Y |  |  |  |
| Esposito *et al.* [43], 2009 | Y |  |  |  |
| Collins *et al.* [67], 2013 |  |  |  | Y |
| Jones *et al.* [23], 2014 |  |  |  | Y |
| Leitao *et al.* [68], 2021 |  |  |  | Y |
| Palm *et al.* [69], 2018 |  |  |  | Y |
| Reis *et al.* [70], 2009 |  |  |  | Y |
| Wing *et al.* [71], 2010 |  |  |  | Y |

Abbreviation: Y, yes (Each “Y” indicates that this trial was included in the systematic reviews or meta-analyses of corresponding column).

Supplementary Table 4. The reference list of the 16 included studies.

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| --- | --- |
| First author, publication year | Information of included studies |
| Esposito *et al*., 2004 | Esposito K, Giugliano F, Di Palo C, Giugliano G, Marfella R, D’Andrea F, D’Armiento M, Giugliano D. Effect of lifestyle changes on erectile dysfunction in obese men: a randomized controlled trial. JAMA. 2004 Jun 23; 291 (24): 2978–2984. doi: 10.1001/jama.291.24.2978. PMID: 15213209. |
| Jones *et al*., 2013 | Jones LW, Hornsby WE, Freedland SJ, Lane A, West MJ, Moul JW, Ferrandino MN, Allen JD, Kenjale AA, Thomas SM, Herndon JE 2nd, Koontz BF, Chan JM, Khouri MG, Douglas PS, Eves ND. Effects of nonlinear aerobic training on erectile dysfunction and cardiovascular function following radical prostatectomy for clinically localized prostate cancer. Eur Urol. May 2014; 65 (5): 852–855. doi: 10.1016/j.eururo.2013.11.009. Epub 2013 Nov 22. PMID: 24315706; PMCID: PMC4089506. |
| Vignera *et al*., 2011 | La Vignera S, Condorelli R, Vicari E, D’Agata R, Calogero A. Aerobic physical activity improves endothelial function in the middle-aged patients with erectile dysfunction. Aging Male. 2011 Dec; 14 (4): 265–272. doi: 10.3109/13685538.2010.544344. Epub 2011 Feb 8. PMID: 21303218. |
| Lamina *et al*., 2009 | Lamina S, Okoye CG, Dagogo TT. Therapeutic effect of an interval exercise training program in the management of erectile dysfunction in hypertensive patients. J Clin Hypertens (Greenwich). 2009 Mar; 11 (3): 125–129. doi: 10.1111/j.1751-7176.2009.00086.x. PMID: 19302423; PMCID: PMC8673270. |
| Maio *et al*., 2010 | Maio G, Saraeb S, Marchiori A. Physical activity and PDE5 inhibitors in the treatment of erectile dysfunction: results of a randomized controlled study. J Sex Med. 2010 Jun; 7 (6): 2201–2208. doi: 10.1111/j.1743-6109.2010.01783.x. Epub 2010 Mar 30. PMID: 20367777. |
| Kałka *et al*., 2013 | Kałka D, Domagała Z, Dworak J, Womperski K, Rusiecki L, Marciniak W, Adamus J, Pilecki W. Association between physical exercise and quality of erection in men with ischaemic heart disease and erectile dysfunction subjected to physical training. Kardiol Pol. 2013; 71 (6): 573–580. doi: 10.5603/KP.2013.0120. PMID: 23797429. |
| Kałka *et al*., 2009 | Kałka D, Sobieszczańska M, Pilecki W, Szawrowicz-Pełka T, Marciniak W, Sebzda T, Turbański J, Palczewska V, Adamus J. Ocena wpływu ambulatoryjnej rehabilitacji kardiologicznej na natezenie zaburzeń erekcji u chorych na chorobe niedokrwienna serca [Evaluation of ambulatory cardiac rehabilitation influence on the intensity of erectile dysfunction in patients with ischemic heart disease]. Pol Merkur Lekarski. 2009 Oct; 27 (160): 290–295. Polish. PMID: 19928656. |
| Zeng HQ *et al*., 2018 | Zeng HQ, Fang XY, Chen ZY. Effect of aerobic exercise on erectile dysfunction in young and middle-aged patients with coronary heart disease [J]. China Modern Medicine, 2018, 25 (29): 40–42 + 57. |
| Dorey *et al*., 2004 | Dorey G, Speakman M, Feneley R, Swinkels A, Dunn C, Ewings P. Randomised controlled trial of pelvic floor muscle exercises and manometric biofeedback for erectile dysfunction. Br J Gen Pract. 2004 Nov; 54 (508): 819–825. PMID: 15527607; PMCID: PMC1324914. |
| Sun Z *et al*., 2022 | Sun Z. Clinical Effect of Pelvic Floor Muscle Training Combined with Regular Use of Tadalafil in the Treatment of Middle-Aged and Elderly Diabetic Erectile Dysfunction [J]. Reflexology and Rehabilitation Medicine, 2022, 3 (06): 68–70 + 78. |
| Kalka *et al*., 2015 | Kalka D, Domagala ZA, Kowalewski P, Rusiecki L, Koleda P, Marciniak W, Dworak J, Adamus J, Wojcieszczyk J, Pyke E, Pilecki W. Effect of Endurance Cardiovascular Training Intensity on Erectile Dysfunction Severity in Men With Ischemic Heart Disease. Am J Mens Health. 2015 Sep; 9 (5): 360–369. doi: 10.1177/1557988314544156. Epub 2014 Jul 30. PMID: 25077728. |
| Kirilmaz *et al*., 2015 | Kirilmaz U, Guzel O, Aslan Y, Balci M, Tuncel A, Atan A. The effect of lifestyle modification and glycemic control on the efficiency of sildenafil citrate in patients with erectile dysfunction due to type-2 diabetes mellitus. Aging Male. 2015; 18 (4): 244–248. doi: 10.3109/13685538.2015.1072154. Epub 2015 Aug 6. PMID: 26248034. |
| Begot *et al*., 2015 | Begot I, Peixoto TC, Gonzaga LR, Bolzan DW, Papa V, Carvalho AC, Arena R, Gomes WJ, Guizilini S. A home-based walking program improves erectile dysfunction in men with an acute myocardial infarction. Am J Cardiol. 2015 Mar 1; 115 (5): 571–575. doi: 10.1016/j.amjcard.2014.12.007. Epub 2014 Dec 18. PMID: 25727080. |
| Lin YH *et al*., 2012 | Lin YH, Yu TJ, Lin VC, Wang HP, Lu K. Effects of early pelvic-floor muscle exercise for sexual dysfunction in radical prostatectomy recipients. Cancer Nurs. 2012 Mar-Apr; 35 (2): 106–114. doi: 10.1097/NCC.0b013e3182277425. PMID: 21915042. |
| Esposito *et al*., 2009 | Esposito K, Ciotola M, Giugliano F, Maiorino MI, Autorino R, De Sio M, Giugliano G, Nicoletti G, D’Andrea F, Giugliano D. Effects of intensive lifestyle changes on erectile dysfunction in men. J Sex Med. 2009 Jan; 6 (1): 243–250. doi: 10.1111/j.1743-6109.2008.01030.x. PMID: 19170853. |
| Maresca *et al*., 2013 | Maresca L, D’Agostino M, Castaldo L, Vitelli A, Mancini M, Torella G, Lucci R, Albano G, Del Forno D, Ferro M, Altieri V, Giallauria F, Vigorito C. Exercise training improves erectile dysfunction (ED) in patients with metabolic syndrome on phosphodiesterase-5 (PDE-5) inhibitors. Monaldi Arch Chest Dis. 2013 Dec; 80 (4): 177–183. doi: 10.4081/monaldi.2013.5234. PMID: 25087294. |

Supplementary Table 5. Excluded trials and reasons for exclusion of meta-analysis.

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| Excluded Trials | Reasons for Exclusion |
| Kalka 2015 | Outcome Indicator No IIEF Score |
| Kirilmaz 2015 | The intervention program did not meet the inclusion criteria |
| Begot 2015 | Outcome Indicator No IIEF Score |
| Lin YH 2012 | Outcome Indicator No IIEF Score |
| Esposito 2009 | Outcome Indicator No IIEF Score |
| Maresca 2013 | Findings cannot exclude the effect of pharmacological interventions |

IIEF, International Index of Erectile Function.