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Review

Effects of Whole-Body Vibration in Older Adult Patients With Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis

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Key Messages

- Whole-body vibration training is effective in increasing mobility, balance and exercise capacity in patients with type 2 diabetes.
- Whole-body vibration is a suitable strategy for the management of patients with type 2 diabetes.

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ABSTRACT

Objectives: The aim of this systematic review and meta-analysis was to determine the effects of whole-body vibration training on metabolic abnormalities, mobility, balance and aerobic capacity in older adult patients with type 2 diabetes mellitus.
Methods: We searched PubMed, Cochrane Library, PEDro, LILACS and SciELO (from the earliest date available to March 2018) for controlled trials that evaluated the effects of whole-body vibration on the health-related outcomes of patients with type 2 diabetes. Two reviewers independently selected the studies and performed statistical analyses of the studies. Weighted mean differences, standard mean differences and 95% confidence intervals (CIs) were calculated.
Results: In total, 7 studies, involving 279 patients who had type 2 diabetes, that compared whole-body vibration with other exercises and/or controls were included. Individual studies suggested that whole-body vibration was associated with improvements in pain levels, blood flow in the legs, glycated hemoglobin levels and fasting blood glucose levels. Whole-body vibration improved mobility weighted mean differences (−.24 seg; 95% CI −2.0, −0.5; n=96); balance standard mean differences (2.34; 95% CI 1.16, 3.5; n=57); and aerobic capacity standard mean differences (0.7; 95% CI 0.2, 1.3; n=59).
Conclusions: Whole-body vibration could be a useful strategy in the management of the symptoms and disabilities associated with type 2 diabetes; however, it is necessary to perform further studies to reinforce the reported findings.

Mots clés :
diabète sucré
exercice
vibrations globales du corps

RÉSUMÉ

Objectifs : L'objectif de la présente revue systématique et de la méta-analyse était de déterminer les effets de l'entraînement par vibrations globales du corps sur les anomalies métaboliques, la mobilité, l'équilibre et la capacité aérobie des patients âgés atteints du diabète sucré de type 2.

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Méthodes : Nous avons effectué des recherches dans PubMed, la Bibliothèque Cochrane, PEDro, LILACS et SciELO (de la plus ancienne date disponible à mars 2018) pour trouver des essais cliniques qui portaient sur l'évaluation des effets des vibrations globales du corps sur les résultats cliniques des patients atteints du diabète de type 2. Deux examinateurs ont choisi de manière indépendante les études et ont réalisé les analyses statistiques des études. Nous avons calculé les différences moyennes pondérées, les différences moyennes standardisées et les intervalles de confiance (IC) à 95 %.
Résultats : Au total, nous avons retenu 7 études comportant 279 patients atteints du diabète de type 2 qui portaient sur la comparaison des vibrations globales du corps à d'autres exercices et/ou aux témoins. Les études individuelles ont montré que les vibrations globales du corps étaient associées à l'amélioration de l'intensité de la douleur, de la circulation sanguine dans les jambes, des concentrations de l'hémoglobine glyquée et des concentrations de la glycémie à jeun. Les vibrations globales du corps ont amélioré les différences moyennes pondérées de la mobilité (−0,24 seg; IC à 95 % −2,0, −0,5; n = 96), les différences moyennes standardisées de l'équilibre (2,34; IC à 95 % 1,16, 3,5; n = 57) et les différences moyennes standardisées de la capacité aérobie (0,7; IC à 95 % 0,2, 1,3; n = 59).
Conclusions : Les vibrations globales du corps pourraient être une stratégie utile à la prise en charge des symptômes et des incapacités associés au diabète de type 2. Toutefois, il est nécessaire de réaliser d'autres études pour conforter les résultats rapportés.

Introduction

Diabetes mellitus is a chronic endocrine disease that involves high morbidity and mortality levels and that is becoming a worldwide public health concern. Type 2 diabetes mellitus, which is characterized by insulin resistance, excessive hepatic glucose production and abnormal fat metabolism, is the most common metabolic disorder in the world (1–3). Diabetes causes abnormalities in small blood vessels that may result in a number of musculoskeletal and vascular complications (4). Peripheral neuropathy is also a common complication of diabetes, and it leads to sensory and motor deficits, which often result in mobility-related dysfunctions (5). As a result, alterations in gait characteristics (lower gait velocity, decreased cadence, shorter stride length, increased stance time and higher step-to-step variability compared with those of healthy controls) and balance impairments, which are responsible for an increased risk of falling, are common in this population. These complications in patients with type 2 diabetes, together with some other musculoskeletal disturbances that include reductions in muscle strength (6), lead to a diminished quality of life in this population (7). To control these changes, physical exercise is considered an effective strategy for handling many of the disabilities and variables associated with the patients' overall fitness and mobility (8).

Studies of patients with type 2 diabetes and of animal models have shown that exercise improves glycemic control (9,10). This beneficial effect is likely to be multifactorial, including increased energy expenditure and insulin-induced membrane translocation of the glucose transporter protein GLUT4 (11). In addition, endurance and/or strength exercises can improve gait speed, balance and muscle strength in patients with type 2 diabetes (12,13). Nevertheless, some of these patients, due to their clinical conditions and/or possible complications (14), are unable or unwilling to perform the exercises at the intensities required to obtain the desired results. Therefore, whole-body vibration training has been investigated in both preclinical and clinical studies to supplement traditional exercise regimens. Lin et al (15) investigated the beneficial effects of whole-body vibration training on body composition, exercise performance and physical fatigue-related and biochemical responses in middle-aged mice. They concluded that whole-body vibration training improved the age-related abnormal morphology of skeletal muscle, liver and kidney tissues (15). Yin et al (11) tested the feasibility of using high-frequency, low-amplitude whole-body vibration therapy to improve glucose metabolism in young mice with type 2 diabetes and reported that whole-body vibration therapy improved glycated hemoglobin (A1C) levels in the mice. After vibration, mice demonstrated less fluid intake and urine excretion and better urinary concentrating ability, and it significantly reduced proinflammatory changes compared to those in the control mice that had not undergone vibration (11). Whole-body vibration training, as a mode of exercise training, is an additional and/or complementary strategy in the management of patients with type 2 diabetes (16).

A recent systematic review and meta-analysis (17) that included 2 studies of patients with type 2 diabetes showed that whole-body vibration training combined with exercise slightly improved glycemic control in an exposure-dependent way. However, this review performed the search in June 2015, and newer studies have been completed and published since then. In addition, the included randomized controlled trials had conflicting results (17). Thus, the aims of our systematic review were to determine the effects of whole-body vibration training on metabolic abnormalities, mobility, balance and aerobic capacity in older adult patients with type 2 diabetes and to provide information concerning the vibration exercise regimens that may be most suitable for improving health in this population.

Methods

This systematic review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (18).

Eligibility criteria

All the controlled trials that studied the effects of whole-body vibration training in patients with type 2 diabetes were included. To be eligible for our review, the trial had to have had patients with type 2 diabetes randomized to at least 1 whole-body vibration group, and their control group had to be composed of patients with type 2 diabetes.

Search methods for the identification of relevant studies

We searched for references on MEDLINE/PubMed, the Physiotherapy Evidence Database (PEDro database), LILACS, SciELO and the Cochrane Central Register of Controlled Trials up to March 2018 without language restrictions. We used a standard protocol for this search and, whenever possible, a controlled vocabulary (MeSH

Table 1
Selected studies, including the levels of evidence, clinical conditions of the participants, outcomes and findings

Study	Sample size and population	Age (yrs)	Outcomes	Findings	PEDro
Lee (25)	N=59 type 2 diabetes (37 male, 22 female) 1. WBV n=29 2. CG (n=13)	>65	• Cold pain threshold • Warm pain threshold • Vibration perception threshold	Warm and cold pain thresholds did not show significant changes in both groups before and after training. Vibration perception threshold showed significant improvement (−9.7±17.3 mm) in the experimental group.	6
Manimmanakorn et al (26)	N=40 type 2 diabetes (23 females and 13 males) 1. WBV: n=17 2. CG: n=20	62.4	• Body composition • Blood pressure • A1C • Fasting blood sugar	No significant difference was found in A1C, fasting blood sugar or insulin levels and insulin sensitivity between WBV and control groups. Compared to the control group, WBV training resulted in a substantial reduction in resting diastolic blood −7.1 mmHg (95% CI −10.9, −3.3)	7
Yoosefinejad et al (27)	N=20 type 2 diabetes (12 females and 8 males) 1. WBV: n=10 2. CG: n=10	55–59	• Muscle strength, • TUG • Unilateral stance test • Balance	Quadriceps muscle strength changed from 12.4±2.4 kg and 12.5±2 kg at the baseline to 15.4±2 kg and 12.2±1.6 kg after the study in WBV intervention and control groups, respectively. Tibialis anterior muscle: tibialis anterior muscle strength changed from 6.3±0.6 kg and 7±1 kg at the baseline to 10.7±1.2 kg and 7±0.8 kg poststudy in WBV intervention and control groups, respectively. TUG changed from 9.3±0.8 s and 9.15±0.4 s to 8.5±0.7 s and 9.8±0.3 s in WBV intervention and control groups, respectively. Percentage of changes between WBV intervention and control groups showed a statistically significant difference ($p<0.05$).	5
Sañudo et al (24)	N=40 type 2 diabetes (19 females and 21 males) 1. WBV: n = 20 2. CG: n=20	56–80	• Body composition • Balance -BBS • TUG • 6MWT	After 12 weeks, significant increments in V med (3.2 cm/s), DV (−0.3 cm/s), weight (−2.3 kg), waist circumference (−6.1 cm), WHR (−0.5) and body fat (−2.3%) were observed after WBV compared with the CG.	5
Lee et al (28)	N=55 type 2 diabetes (31 females and 24 males) 1. WBV: n=19 2. CG: n=18 3. Balance exercise: n=18	>65	• Muscle strength (FTSTS) • Balance (BBS) • TUG • A1C	Significant improvements were noted in the BBS (1.89 ±1.52), muscle strength (−3.68±2.40 sec), and A1C (−0.06±0.10) in the WBV group compared to the CG.	6
Behboudi et al (29)	N=30 type 2 diabetes (100% males) 1. AE: n=10 2. WBV: n=10 3. CG: n=10	45–65	• A1C, • Fasting glucose • Insulin.	After 8 wks of exercise, no significant differences in any of the variables between AE and WBV were found. A significant decrease in fasting glucose was observed in the exercise groups (AE and WBV) compared with the CG.	2
Baum et al (30)	N=40 type 2 diabetes (24 male, 16 female) 1. flexibility: n=13 2. strength group: n=13 3. WBV: n=14	56–70	• Fasting glucose • OGTT • A1C levels • Isometric torque • Endurance capacity	The area under curve and maximal glucose concentration after OGTT were reduced in the WBV and strength-training group. A1C values tended to decrease below baseline date in the WBV group, while they increased in the 2 other intervention groups.	4

AE, Aerobic exercise; *A1C*, fasting glycolated hemoglobin level; *BBS*, Berg balance scale; *BF*, blood flow; *BMI*, body mass index; *CG*, control group; *COP*, center of pressure; *DV*, maximum diastolic velocity; *EMGrms*, electromyography root mean square; *FTSTS*, 5 times-sit-to stand; *MDNS*, Michigan diabetic neuropathy score; *MQ*, methodologic quality; *NC*, not classified; *NPS*, neuropathic pain scale; *OGTT*, oral glucose tolerance test; *PEDro*, Physiotherapy Evidence Database Scale; *PN*, peripheral neuropathy; *6MWT*, 6-min walking test; *TUG*, Timed Up and Go test; *UST*, unilateral stance test; *VAS*, visual analog scale; *Vmed*, mean velocity; *WBV*, whole body vibration; *WHR*, waist-to-hip ratio.

term for MEDLINE and Cochrane). For our search strategy, we used 3 groups of keywords and their synonyms: study design (controlled trials); participants (patients with type 2 diabetes); and interventions (whole-body vibration training). For the identification of controlled trials in the PubMed database, we used an optimally sensitive strategy that was developed for the Cochrane Collaboration (19). In our search, we used the following keywords: whole body vibration, vibration intervention, vibration platform, diabetes, diabetes mellitus and type 2 diabetes. The reference lists of all the articles eligible for inclusion in our systematic review, and they were analyzed in order to detect other eligible studies. For ongoing studies, or when the confirmation of any data or additional information was required, the authors were contacted by e-mail.

Data collection and analysis

A search strategy was used to obtain the titles and abstracts of studies that could be relevant for our systematic review. Two authors independently evaluated each abstract that was identified in the search. If at least 1 of the authors considered a reference to be

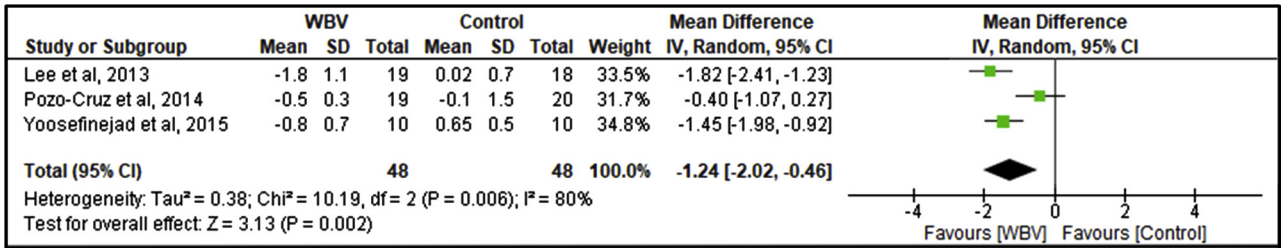

Figure 1. Change in mobility, WBV vs control. Mobility measured by the timed up-and-go test. Review Manager (RevMan), v.5.3, The Cochrane Collaboration, 2013. *WBV*, whole-body vibration.

eligible, the full text was obtained. Two authors independently evaluated the full-text papers for eligibility according to the inclusion and exclusion criteria, using a standardized data-extraction form.

Two authors independently extracted data from the published reports by using the standard data-extraction forms that were adapted from the Cochrane Collaboration (19) model. The authors extracted descriptive and outcome data from the included studies. Aspects of the study population, such as the average age and sex, aspects of the intervention performed (sample size, type of whole-body vibration, sets, amplitude, presence of supervision, frequency and duration of each session); follow-up (if the patients included were analyzed); loss to follow-up (if there was a loss in the sample); and outcome measures. The presented findings were extracted. Any further information that was required from the original author was requested by e-mail.

Quality assessment of studies included in the meta-analysis

The quality of the studies included in our systematic review was scored by 2 researchers using the PEDro scale (20), which is a useful tool for assessing the quality of physical therapy and rehabilitation trials based on a Delphi list that consists of 11 items (20). Two researchers independently scored the studies using a score of 0 to 10.

Statistical assessment

The pooled-effect estimates were obtained by comparing the least square mean change from baseline to endpoint for each group and were expressed as the weighted mean difference among the groups. When the standard deviation (SD) of change was not available, the SD of the baseline measure was used for the meta-analysis. The calculations were performed using a fixed-effects and random-effects model. If the trial was a multiple-arm randomized controlled trial, data were extracted from all relevant experimental intervention groups (whole-body vibration training vs. control group). In follow-up reports with multiple endpoints, only the data closest to the end of the exercise program were included. In crossover trials, size effects were extracted only at the first crossover point. A p value $\leq$0.05 was considered significant. Heterogeneity among the studies was examined by Cochran's Q and I^2 statistics, in which values greater than 50% were considered indicative of high heterogeneity (21), and the random-effects model was chosen. Analyses were performed by using Review Manager (v. 5.3) (Cochrane Community, London, United Kingdom) (22).

Results

Description of selected studies

The initial search led to the identification of 217 potentially relevant studies, of which 15 studies were retrieved for detailed analyses. After a complete reading of these 15 articles, 6 were excluded. Of the remaining 9 articles, 3 (16,23,24) referred to the same original study and were, therefore, considered a single study. This resulted in 7 studies (24–30) that included a total of 279 participants. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis flow diagram of the studies in this review can be found in Supplementary Figure 1.

The number of randomized participants in this systematic review ranged from 20 to 59 (25,27). The mean age of the participants ranged from 45 to 80 years. The sample size, outcomes and results of the included studies are summarized in Table 1. All the studies were scored using the PEDro scale methodology by both authors, and the results are presented individually in Table 1.

Several outcomes were assessed in the included studies: body composition, A1C levels, fasting blood glucose levels, endurance and muscle strength, blood flow, pain with visual analogic scale, aerobic capacity, balance, measurement of the centre of pressure and mobility by the Timed Up-and-Go test. The characteristics of the included studies are shown in Table 1.

The analyzed parameters of the mechanical vibration included the frequency and amplitude or peak-to-peak displacement, position of the individual on the base of the platform and a description of the protocols used (working time, number of sessions or rest time). The type of platform used was clearly defined in the studies as either a synchronous (27) or side-alternating (16,23,24) platform. Considering the biomechanical parameters, the range of the frequency of the mechanical vibrations varied from 12 to 35 Hz, and the range of the amplitude varied from 2 to 4 mm. In general, the patients stood in a squat position on the base of the platform with the flexion of their knees varying from 30 to 100 degrees. Nevertheless, in the study performed by Sañudo et al (24), the whole-body vibration training included leg exercises while standing on a whole-body vibration-training platform. A complementary table with the whole-body vibration intervention characteristics of the included studies can be found in Supplementary Table 1.

Baum et al (30) used a protocol in which the participants performed 8 types of exercises and positions. The number of sessions per week varied from 1 (27) to 3 (16,23,24,29,30), and the total duration of the programs varied from a single session to 12 weeks. In general, the participants had rest times between the bouts (working time) in each session of 30 s or 1 min. Yoosefinejad et al (27) did not report whether there was a rest time or whether it was only a single exposure.

Yoosefinejad et al (27) observed that the neuropathy score significantly decreased. Del Pozo-Cruz et al (16) observed significant between-group differences in the measurement of the centre of pressure excursions in the anteroposterior and mediolateral directions with the participants' eyes closed and their feet both apart and together after 12 weeks of whole-body vibration training. Improvements in balance and the Timed Up-and-Go test after whole-body vibration training were also reported by Yoosefinejad et al (27). Behboudi et al (29) and Pozo-Cruz et al (16) reported an

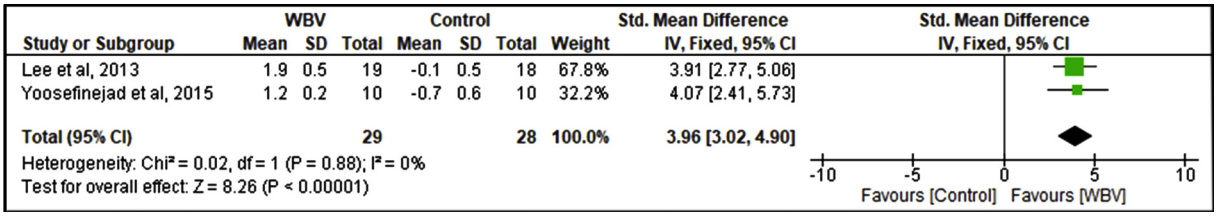

Figure 2. Change in balance, WBV vs control. Balance measured by unilateral-stance test and the Berg balance scale. Review Manager (RevMan), v.5.3, The Cochrane Collaboration, 2013. *WBV*, whole-body vibration.

improvement in aerobic capacity. In addition to these changes, improvements in muscle strength were observed in 3 studies (27,28,30). The muscle strength was assessed by both an isometric dynamometer (27,30) and the 5-times-sit-to-stand test (28). Improvements in blood flow (24), A1C levels (23,28,30) and fasting blood glucose levels (23,29) were observed after whole-body vibration training.

Three studies (23,27,28) assessed mobility by the Timed Up-and-Go test. A total of 96 patients were included in these 3 studies. The meta-analyses (Figure 1) showed significant improvement in mobility at −1.24 seg (95% CI −2.0, −0.5, n=961) for participants in the whole-body vibration training group compared with the control group.

Two studies (27,28) assessed balance, 1 having used the Unilateral-Stance test (27) and 1 having used the Berg balance scale (28). A total of 57 patients was included in these 2 studies and, due to the difference between the instruments used in the assessment of balance, we performed a meta-analysis with the standardized mean difference. The meta-analyses (Figure 2) showed a significant improvement in balance of 3.96 (95% CI 3, 4.9, n=57) for participants in the whole-body vibration training group compared with the control group.

Two studies (23,29) assessed aerobic capacity; 1 used the 6-min walk test (23) and the other used the 1-mile track walk test (29). A total of 59 patients were included in these 2 studies and, because of the difference between the instruments used in the assessment of aerobic capacity, we performed a meta-analysis with the standardized mean difference. The meta-analyses (Figure 3) showed a significant improvement in aerobic capacity of 0.7 (95% CI 0.2, 1.3, n=59) for participants in the whole-body vibration training group compared with the control group.

Discussion

The main results of our systematic review are that whole-body vibration training effectively increases mobility, balance and aerobic capacity in patients with type 2 diabetes and represents a potential rehabilitation technique for these patients. Two studies (28,30) included in our systematic review showed that whole-body vibration training had positive effects on A1C and fasting blood glucose levels.

Whole-body vibration training combined with low-level exercise appears to be a safe and feasible intervention (23,27) to help improve A1C levels, cardiovascular risk factors and physical and functional capacity in patients with type 2 diabetes compared to no intervention (17). Our systematic review is important because it analyzes whole-body vibration training as a potential coadjuvant modality in rehabilitation. Considering the clinical characteristics of individuals with type 2 diabetes, interventions aimed at increasing muscle strength, balance and blood parameters are fundamental in improving the functionality of these individuals.

However, whole-body vibration training effects have to be interpreted with caution because of the heterogeneity of the protocols and the different types of exercises performed. The frequency of the vibrations in the studies analyzed ranged from 12 Hz to 35 Hz, and the amplitude ranged from 2 mm to 4 mm. This wide range in the biomechanical parameters may be important because the vibrations' effects on leg muscle activity were reported to be greater at vibration frequencies between 35 Hz and 45 Hz in comparison with lower frequencies (<35 Hz) for both static and dynamic exercises (31). Moreover, there is evidence that indicates electromyographic activity would linearly increase due to the vibration frequency in the range of 5 Hz to 30 Hz (31–34). These discrepancies make it difficult to select parameters for the prescription of an exercise protocol in this population. Thus, professionals should be cautious in prescribing whole-body vibration training programs for patients with type 2 diabetes.

Improvements in both balance and mobility were also observed (23,27,28), and these findings could be associated with a possible response to the vibration stimulus (tonic vibratory reflex). A greater activation of motor units may lead to a better muscle response (35). Smith et al (36) observed that balance and leg strength in older adults improved with whole-body vibration training and suggested a positive impact on functional independence. The oscillatory motions of whole-body vibration training induce length changes in the muscle groups and, therefore, stimulate the primary endings of the muscle spindle receptors that cause reflexive contraction. In fact, neuromuscular performance increases when these reflexive contractions are added to voluntary skeletal muscle activation (37,38).

The results of this study should be interpreted with caution due to the methodologic variations concerning the biomechanical

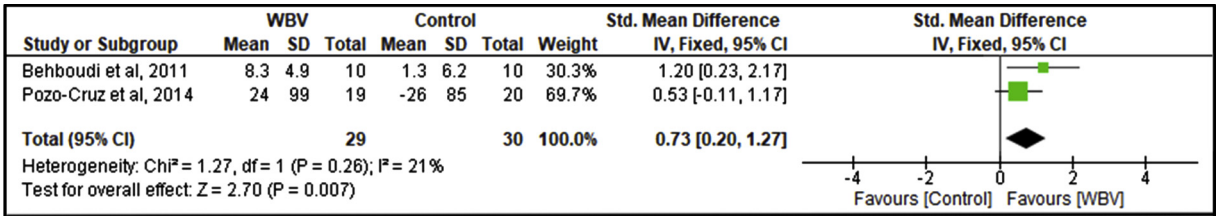

Figure 3. Change in aerobic capacity, WBV vs control. Aerobic capacity measured by the 6-min walk test and the 1-mile track walk test. Review Manager (RevMan), v.5.3, The Cochrane Collaboration, 2013. *WBV*, whole-body vibration.

parameters, the type of oscillating/vibratory platform and the variability of the protocols used. In addition, the populations included in these studies was heterogeneous due to differences in age or symptomatology.

Considering the limitations of this study and comparing its findings with those of the studies in the literature, we note that whole-body vibration training improved the mobility, balance and aerobic capacity of patients with type 2 diabetes without any known adverse effects. Further research is needed to determine the optimum dosages and durations of effect.

Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the *Canadian Journal of Diabetes* at https://www.canadianjournalofdiabetes.com.

Author Disclosures

Conflicts of interest: None.

Author Contributions

MGN, DCSC, LLPD, AAB, MFN, PJM, BS and MBF participated in the elaboration and execution of the study. MGN, DCSC and LLPD accessed the bibliographical database. All the authors analyzed and discussed the data of the study. DSC, LLPD and MBF wrote the manuscript. MGN and MBF elaborated the meta-analysis. AAB, MFN, PJM, BS and MBF reviewed the final version of the manuscript. All the authors read and approved the final version of this investigation.

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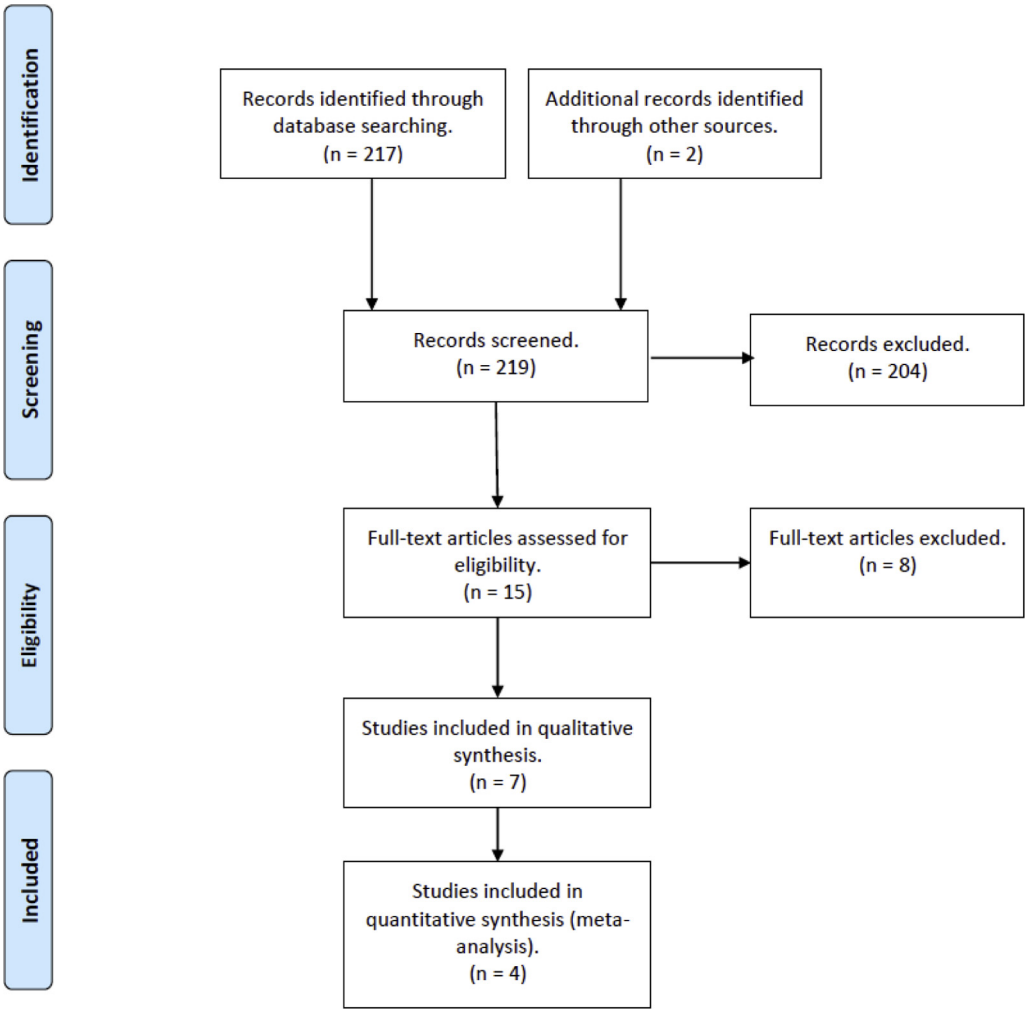
Appendix



Supplementary Figure 1. Flow diagram showing the reference screening and study selection.

Supplementary Table 1
Description of the whole-body vibration training protocols

Study	Type of overvoltage protector	Frequency (Hz)	Amplitude (mm)	Position	Sessions (×/wk) Duration (weeks)	Time (min) Sets (reps)/rest between sets (s)
Lee (25)	Side-alternating	12	1–3	The subjects stood on the platform with their feet bare, at shoulder width, and stared at the front. The subjects bent the knees a little (30°) so that vibration did not reach up to the head.	3 6	11 (3 × 3min, 60 s rest)
Manimmanakorn et al (26)	Synchronous	30–40	1–3	The 6 static positions consisted of: 1) a deep squat position (knee angle 90°); 2) high squat position (knee angle 125°); 3) high squat position (with raised heels); 4) slight knee flexion 1 (holding hand straps with shoulder flexion); 5) slight knee flexion 2 (holding hand straps with shoulder abduction); and 6) slight knee flexion 3 (holding hand straps with elbow flexion).	3 12	36 (2 × 6–60 s, 20 s rest)
Yoosefinejad et al (27)	Synchronous	30	2	The subjects stood barefoot on the plate with 30 degrees of knee flexion. All participants were asked to contract the muscles of the lower limbs during exposure to vibration.	2 6	Time increased every 2 weeks from 30 s initially to 45 s for 3rd and 4th weeks and to 1 min for the 2 last weeks.
Sañudo et al (24)	Side-alternating	12-16	4	Eight different dynamic and static exercises on the platform (lunge, step up and down, squat, calf raises, left and right pivots, shoulder abduction with elastic bands, shoulder abduction with elastic bands while squatting, arm swinging with elastic bands).	3 12	12–20 (8 × 30–60 s, 30 s rest)
Lee et al (28)	Side-alternating	15–30	1–3	Subjects stood upright on the platform, and were vibrated in a 110° squatting position over clearly marked foot positions, wearing normal footwear and using a handrail for support if required.	3 6	60 (3 × 3 min, 60 s rest)
Behboudi et al (29)	Side-alternating	30	2	Stand up and 110° semisquat positioning	3 8	16–24 (8 × 1 min, 60 s rest),
Baum et al (30)	Synchronous	30–35	2	Eight different positions and exercises	3 12	12–20 (8 exercises × 30 s)