WHOLE-BODY VIBRATION TRAINING FOR CHILDREN WITH NEUROLOGICAL DISABILITIES: A META-ANALYSIS

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Review
DOI 10.26582/k.55.1.17

Abstract:

Over the years, the concern over bone health deterioration in children with neurological disabilities (ND) has caught the interest of the research community. As the current traditional exercise methods are considered too challenging for children with ND, it is essential to seek effective rehabilitation programs with minimum difficulties and movement restrictions for children with disabilities, ultimately improving their muscle and bone health. Therefore, this study was performed to evaluate the potential application of whole-body vibration training (WBVT) as a beneficial and effective approach to improving bone mineral density (BMD), total body bone mineral content (BMC), and lean mass in children with ND. The impact of WBVT on children with ND was investigated using a systematic review and meta-analysis approach following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A database search was conducted to screen and select previous literature sources published from January 2002 to July 2022 from EBSCO, PubMed, Scopus, and Web of Science databases that met the inclusion and exclusion criteria. Following the quality assessment (PEDro scale and NIH scale) and sensitivity analysis, the standardized mean difference (SMD) was conducted using the STATA 15.1 software with a 95% confidence interval (95% CI) (PROSPERO registration number: CRD42022343789). Eight studies (four randomized controlled trial [RCT] and four non-RCT studies) were selected, which involved 184 male and 130 female participants. Based on the PEDro scale, all RCT studies were classified as high methodological quality, while the NIH scale rated all non-RCT papers as "Good". In addition, the meta-analysis results indicated that WBVT substantially enhanced femur BMD [($p<.01$, $z = 3.37$), SMD (95% CI) = 0.47 (0.20, 0.74)], lumbar spine BMD [($p=.02$, $z = 2.32$), SMD (95% CI) = 0.32 (0.05, 0.58)], total body BMC [($p<.01$, $z = 3.42$), SMD (95% CI) = 0.29 (0.12, 0.46)] and lean mass [($p<.01$, $z = 2.80$), SMD (95% CI) = 0.25 (0.07, 0.42)] of children with ND. However, the effect of WBVT was insignificant on the total body BMD of children with ND [($p=.22$, $z = 1.24$), SMD (95% CI) = 0.14 (-0.08, 0.37)]. The meta-analysis demonstrated the significant effect of WBVT on the femur BMD, lumbar spine BMD, total body BMC, and lean mass in children with ND. Hence, WBVT can be suggested as a complementary treatment prescription for children with ND.

Key words: *neurological disabilities, whole-body vibration training, bone mineral density*

Introduction

The growing concern over the deterioration of bone health in children with neurological disabilities (ND) in recent years has gained the attention of the research community (Henderson, Lin, & Greene, 1995; Mergler, et al., 2012; Zacharin, 2004). It is a fact that children with Down syndrome (DS) and cerebral palsy (CP) exhibit a higher risk of developing low bone mineral density (BMD), which may be due to muscular hypotonia. Consequently, they are exposed to a higher risk of low-impact bone fractures (García-Hoyos, Riancho, & Valero, 2017; Mus-Peters, et al., 2019). Although increasing muscle mass and activity could substantially reduce the risk of bone fracture (Modlesky & Zhang, 2020; Ritzmann, Stark, & Anne, 2018), children with ND are at a disadvantage to adapt to and endure the current traditional exercise methods. Thus, the major challenge is to develop a compatible and effective rehabilitation program for them.

Recently, there is a growing interest in the development of whole-body vibration training

(WBVT) as a potential therapeutic approach to improve the function of lower limb muscle and bone mass among children suffering from neurological dysfunctions and compromised exercise (Matute-Llorente, Gonzalez-Aguero, Gomez-Cabello, Vicente-Rodriguez, & German, 2014; Saquetto, Carvalho, Silva, Conceiçao, & Gomes-Neto, 2015; Saquetto, et al., 2018). In a basic WBVT approach, the patient is asked to stand on a vibrating plate and either holding onto a support frame, hands-free, or equipped with additional devices to maintain their position on the plate (García-Hoyos, Riancho, & Valero, 2017). The vibration intensity of the plate can be further adjusted according to several parameters, including the amplitude, frequency, acceleration, and type of the vibration plate (Rauch, et al., 2010). It was inferred that the enhanced mechanical stress and activation of the proprioceptive spinal circuits from the WBVT session would trigger the Golgi tendon organs and muscle spindles, resulting in an enhanced muscular function (Cardinale & Bosco, 2003). Furthermore, it was believed that the increased mechanical load would induce bone adaptation via numerous pathways, which are mostly assumed as independent of the muscle response (Beck, 2015).

To date, the effect of WBVT on BMD and the lean mass of children with ND has yet to be discovered. Previously, a meta-analysis study was performed to explore the effect of vibration training on the BMD and lean mass of children with motor disabilities (Li, et al., 2022). Nevertheless, DS children were not included in the study and the findings overlooked the changes in BMD in the whole body. Chen, Ma, Lu, & Ma (2017) also carried out a meta-analysis and compared the influence of WBVT on the lean mass of thermally injured or DS children. The two studies recorded high heterogeneity and low stability. While several studies have reported a significant improvement in the bone mineral content (BMC) and lean mass of children with ND through WBVT (Duran, et al., 2020a; El-Bagalaty & Ismaeel, 2021), two other studies demonstrated opposing results (Matute-Llorente et al., 2015, 2016). Hence, our study reported the meta-analysis of the effect of WBVT on the BMD and lean mass among children with ND, with the aim of evaluating whether WBVT can be an effective treatment method.

Materials and methods

Protocol and registration

The review protocol was registered with the International Prospective Register of Systematic Reviews on July 12, 2022 (Registration number: CRD42022343789).

Data sources and study selection

Four research databases, namely EBSCO, PubMed, Web of Science, and Scopus, were utilized to search for previous literature studies containing the terms "WBV", "whole-body vibration", "down syndrome", "cerebral palsy", "exercise", "training", "children", and "adolescents". The publication range for the database search was set from January 2002 to January 2023 with the final day of retrieval being July 5th, 2022. Appendix A provides the search strategy and findings for each database. The retrieved titles and abstracts were first evaluated by two independent investigators. The selected papers were then thoroughly assessed based on the exclusion and inclusion criteria. The third investigator would assist in reaching a consensus should any dispute arise between the two investigators. After deciding on the inclusion of the study, the authors review its reference list again to prevent omissions of literature that can be included. Figure 1 illustrates the complete article selection process. Note that the systematic review and meta-analysis employed in the present study were in line with the suggested recommendations by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Li, et al., 2022).

Inclusion and exclusion criteria

The inclusion and exclusion criteria consist of six main features: 1) the paper should be based on randomized controlled trial (RCT) and cohort studies; 2) the age of participants was fixed within the range of 3–18 years; 3) the intervention programs should involve WBVT; 4) the output indicators must include the BMD and lean mass; 5) a dual-energy X-ray absorptiometry (DXA) was applied to evaluate the output index; and 6) the paper should be written fully in the English language. In addition, grey literature, including poster presentations, conference proceedings, or abstracts, was not selected and it was removed from the screening process.

Quality assessment

The PEDro scale (de Morton, 2009) was employed to assess the quality of the selected RCT studies. The quality evaluation was also completed by two independent researchers. If there was a difference in scores, the third researcher would assist in reaching a consensus. High methodological quality was indicated when the score was 6 or higher, while a low methodological quality (Suárez-Iglesias, Miller, Seijo-Martínez, & Ayán, 2019) referred to a score below 6. In contrast, the "Quality Assessment Tool for Before-After (Pre-Post) Studies with No Control Group" (NIH) scale

(Ma, et al., 2020) (available online: https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools [accessed on 9th March 2022]) was applied to determine the quality of the selected non-RCT studies. The quality of each study was ranked as "good", "fair", or "poor". The PEDro and NIH scales consisted of 11 and 12 questions, respectively.

Risk of bias assessment

The sensitivity analysis was performed by removing each study one by one to examine the stability of the meta-analysis findings. A funnel plot was then utilized to analyze the publication bias of the study.

Data analysis

The input of every applicable output variable was keyed into a STATA 15.1 software (version 21.0, College Station, TX, USA) for the meta-analysis examination. Despite that the selected studies exhibited continuous output variables, the equipment and test units in each study were different. Thus, the standardized mean difference (SMD) was adopted as the index of effect scale with a 95% confidence interval (95% CI). The I^2 statistic was used to determine the heterogeneity between the studies. Generally, an I^2 value that equals to or more than 50% indicates the presence of heterogeneity between the studies. Hence, the analysis should be conducted using a random effect model. Conversely, a non-heterogeneity between the studies is determined when the I^2 is lower than 50%, thus, the analysis should be conducted using a fixed-effect model.

Results

Eligibility of studies

A total of four RCT and four non-RCT studies were selected to determine the effect of WBVT on lean body mass and BMD in children with neurological impairments (Table 1). The selected studies comprised only the baseline and final data following the intervention program. The studies were ethically approved by their respective institutions and the two researchers recorded a Cohen's kappa coefficient of 0.909. The eight selected studies involved 184 male and 130 female participants with a minimum and maximum of 12 weeks and 6 months of the intervention period, respectively. Four studies reported the femur BMD, while six studies described the lumbar spine BMD, total body BMC, and lean mass. The range of the vibration frequency was between 5 and 30 Hz.

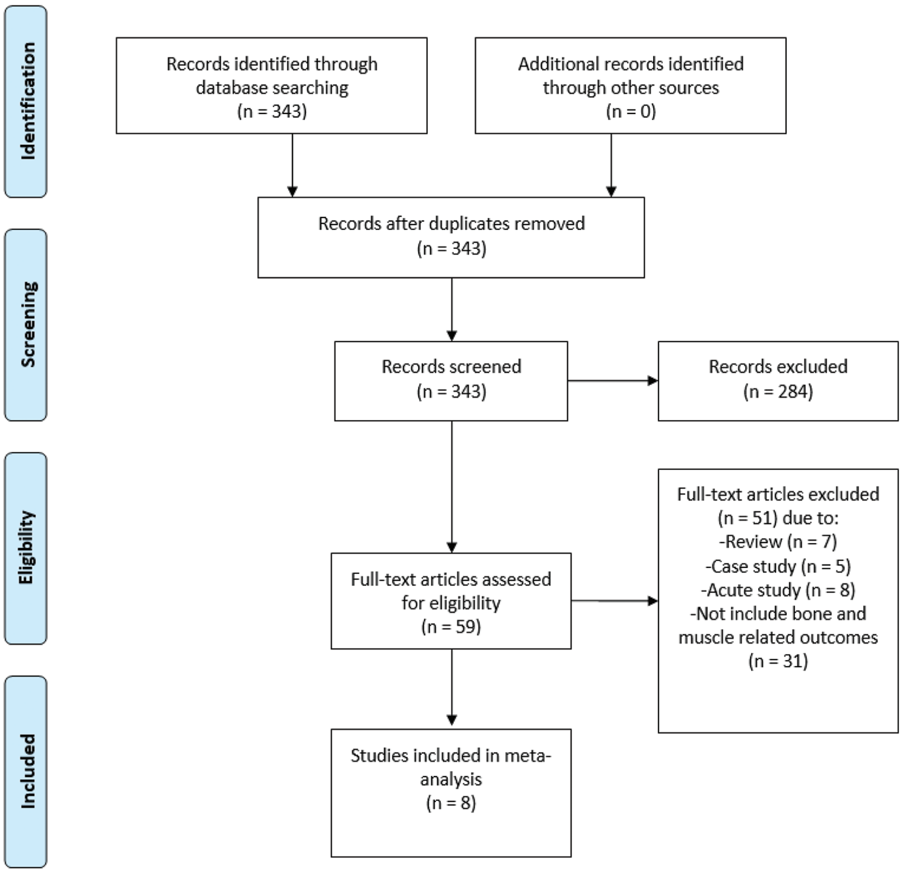

Figure 1. Flow diagram of the search results based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA).

Table 1. Characteristics of the selected studies

Reference	Type	Age (year)	Gender	Population	Duration	WBVT program	Index	DXA device
Bagalaty, 2021	RCT	5.0 ± 0.8	10M/13F	CP	12 weeks; 3x/week	5–25 Hz; OA = 0–3.9 mm; erect position, squatting, and side-standing for 20 min; side-alternating vibrations	Lumbar spine BMD; femur BMD	DP3, Lunar Corporation, USA
Duran, 2020	Cohort	11.9 ± 2.7	76M/52F	CP	6 months; 2181±564 min	8–20 Hz; OA = 1–2 mm; standing on a 40° inclined pedal and train for 15 min; side-alternating vibrations	Total body BMC; lean mass	GE, UK
Gusso, 2020	Cohort	15.5 ± 2.3	8M/3F	DS	20 weeks; 4x/week	12–20 Hz; OA= 1 mm; standing on a vibration pedal with knees bent and train for 9 min; side-alternating vibrations	Lumbar spine BMD; femur BMD; total body BMC; total body BMD; lean mass	GE Lunar Prodigy, USA
Gusso, 2016	Cohort	16.2	23M/17F	CP	20 weeks; 4x/week	15–20 Hz; OA = 1 mm; standing on a vibration pedal with knees bent and train for 9 min; side-alternating vibrations	Lumbar spine BMD; femur BMD; total body BMC; total body BMD; lean mass	GE Lunar Prodigy, USA
Matute-Llorente, 2015	RCT	15.0±2.0	7M/6F	DS	20 weeks; 3x/week	25–30 Hz; OA = 2 mm; the squatting position (bent knees at 90°) on the platform and train for 5–10 min; side-alternating vibrations	Lumbar spine BMD; femur BMD; total body BMC; total body BMD	QDR Discovery, Hologic Inc, USA
Matute-Llorente, 2014	RCT	15.5±3.0	8M/3F	DS	20 weeks; 3x/week	25–30 Hz; OA = 2 mm; the squatting position (bent knees at 90°) on the platform and train for 5–10 min; side-alternating vibrations	Lumbar spine BMD; femur BMD; total body BMC; total body BMD	QDR Discovery, Hologic Inc, USA
Ruck, 2010	RCT	8.2± 0.9	8M/2F	CP	6 months; 5x/week	12–18 Hz; OA = 4 mm; standing on a 35° inclined vibration pedal and train for 15 min; side-alternating vibrations	Lumbar spine BMD; femur BMD	QDR Discovery, Hologic Inc, USA
Stark, 2010	Cohort	9.8	44M/34F	CP	6 months; 1x/day	5–25 Hz; OA = 0–3.9 mm; standing on a vibration pedal and train for 15 min; side-alternating vibrations	Total body BMC; total body BMD; lean mass	GE, Germany

Note. RCT = randomized controlled trial; M = male; F = female; BMD = bone mineral density; BMC = bone mineral content; WBVT = whole-body vibration training; CP = cerebral palsy; DS = Down syndrome; OA = oscillation amplitude.

Quality assessment

Table 2 shows that the total scores of the PEDro scale for all the selected RCT studies (El-Bagalaty & Ismaeel, 2021; Genetos, Cheung, Decaris, & Leach, 2010; Matute-Llorente, et al., 2015, 2016) were higher than 5 points and classified as high methodological quality. For the non-RCT studies (Duran, et al., 2020; Gusso, et al., 2016, 2021; Stark, Nikopoulou-Smyrni, Stabrey, Semler, & Schoenau,

Table 2. Depiction of the risk of bias assessment

PEDro scale		1	2	3	4	5	6	7	8	9	10	11	Total
Bagalaty, 2021		Y*	Y	N	Y	N	N	N	Y	Y	Y	Y	6/10
Ruck, 2010		Y*	Y	Y	Y	N	N	N	N	Y	Y	Y	6/10
Matute-Llorente, 2014		Y*	Y	Y	Y	N	N	N	Y	Y	Y	Y	7/10
Matute-Llorente, 2015		Y*	Y	Y	Y	N	N	N	Y	Y	Y	Y	7/10
NIH Pre-Post tool	1	2	3	4	5	6	7	8	9	10	11	12	Total
Duran, 2020	Y	Y	Y	N	Y	N	N	N	Y	Y	Y	NA*	7/11
Gusso, 2016	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	NA*	9/11
Gusso, 2020	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	NA*	9/11
Stark, 2010	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	NA*	9/11

Note. Y = yes; N = no; NA = not applicable; NR = not reported. * Not included in the total score.

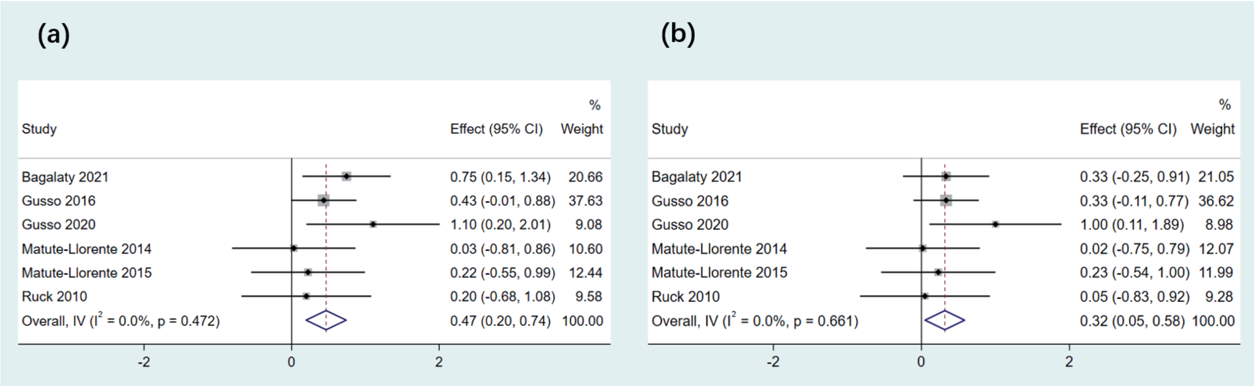

Figure 2. Forest plot illustrating the effects of WBVT on the (a) femur and (b) lumbar spine BMD of children with ND.

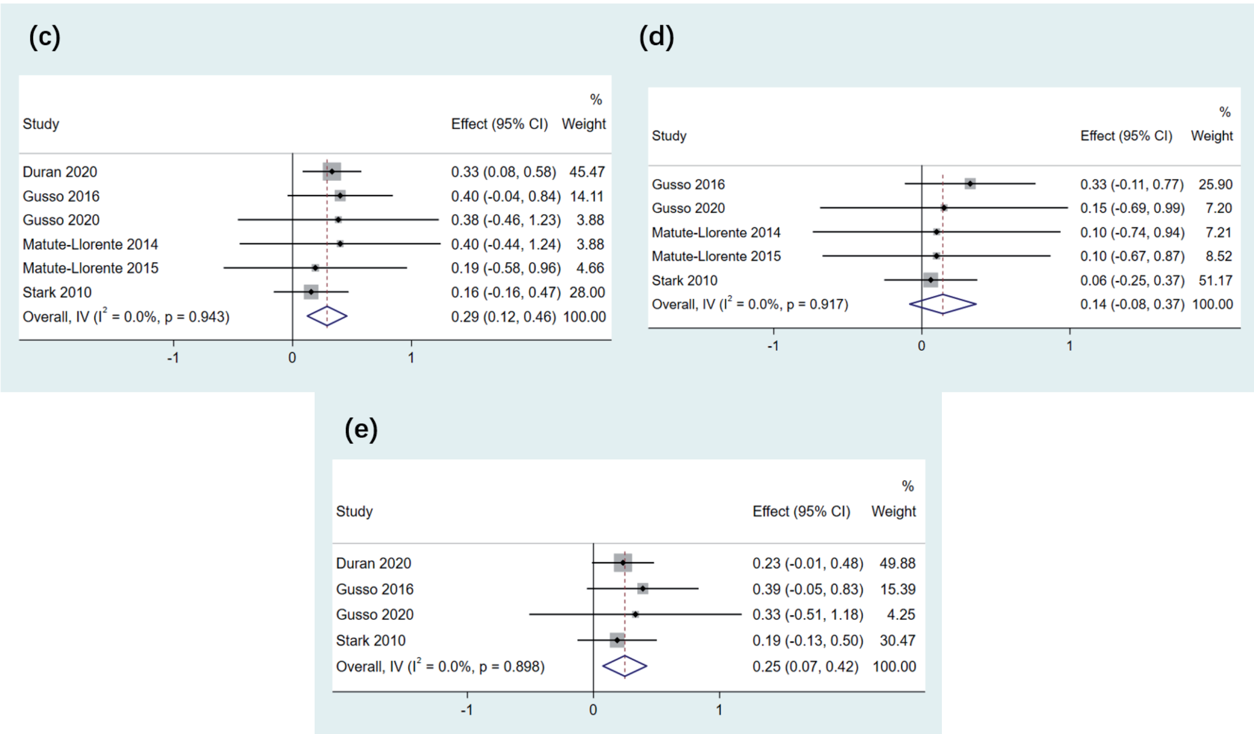

Figure 3. Forest plot illustrating the effects of WBVT on the (c) total body BMC, (d) total body BMD, and (e) lean mass of children with ND.

2010), the overall quality rating from the NIH scale was “good”.

Quantitative synthesis

Six studies (n = 108) analyzed the effect of WBVT on the femur and lumbar spine BMD in children with ND. Based on the Forest plot in Fig. 2a, the WBVT significantly enhanced the femur BMD in children with ND ($p<.01$, $z = 3.37$), SMD (95% CI) = 0.47 (0.20, 0.74). However, the heterogeneity between the studies was insignificant ($p=.47$, $I^2 = 0.0\%$) as well as across the studies ($p=.66$, $I^2 = 0.0\%$). In contrast, the Forest plot in Fig. 2b illustrates the significant impact of WBVT on the lumbar spine BMD in children with ND ($p=.02$, $z = 2.32$), SMD (95% CI) = 0.32 (0.05, 0.58).

Furthermore, the effect of WBVT on the total body BMC, total body BMD, and lean mass in chil-

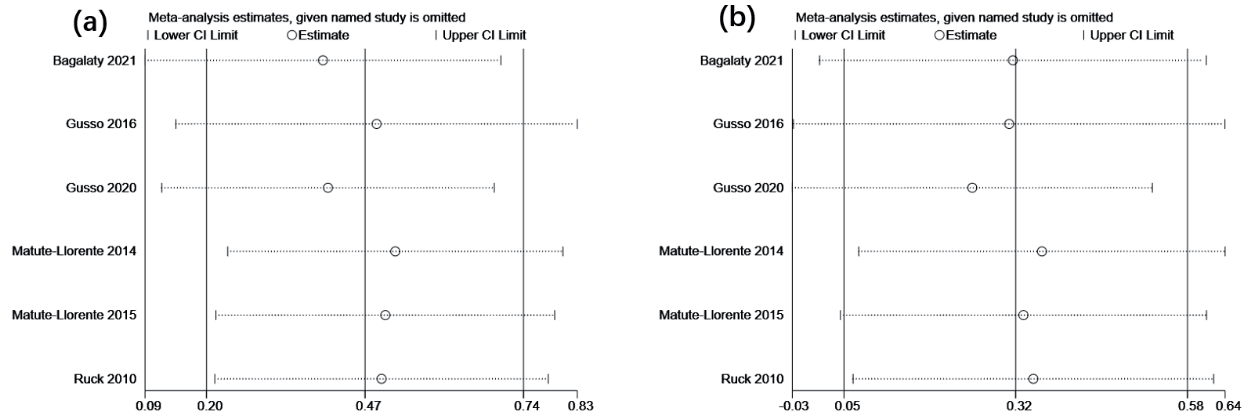

Figure 4. Sensitivity analysis illustrating the effects of WBVT on the (a) femur and (b) lumbar spine BMD of children with ND.

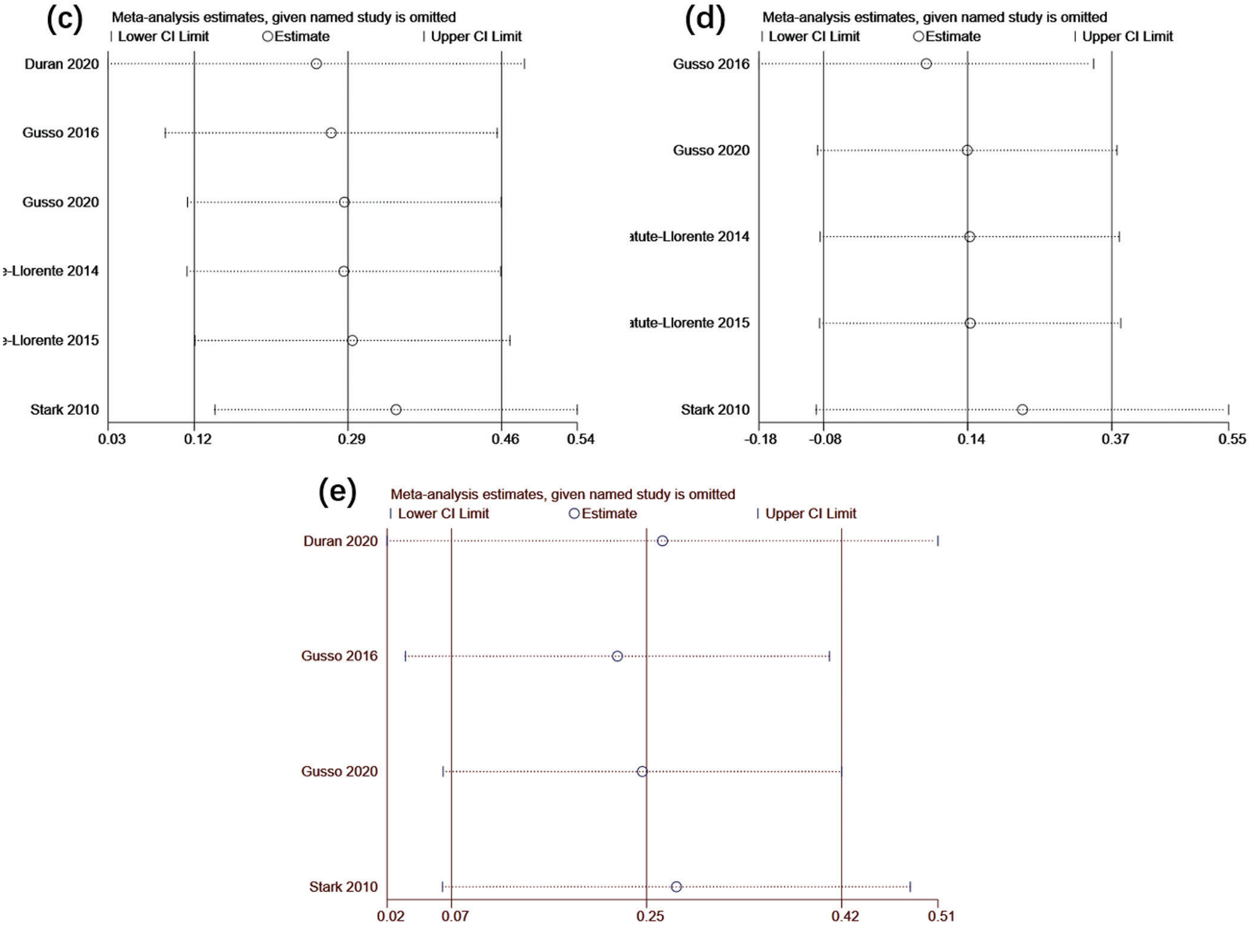

Figure 5. Sensitivity analysis illustrating the effects of WBVT on the (c) total body BMC, (d) total body BMD, and (e) lean mass of children with ND.

dren with ND was evaluated in six (n = 281), five (n = 153), and four studies (n = 257), respectively. The Forest plot in Fig. 3c portrays that the WBVT significantly enhanced the total body BMC ($p<.01$, $z = 3.42$), SMD (95% CI) = 0.29 (0.12, 0.46) as well as lean mass in children with ND ($p<.01$, $z = 2.80$), SMD (95% CI) = 0.25 (0.07, 0.42), as shown in Fig. 3e. On the contrary, the findings recorded an insignificant difference of the heterogeneity between the studies ($p=.94$, $I^2 = 0.0\%$) and across the studies ($p=.90$, $I^2 = 0.0\%$). Although the Forest plot in Fig. 3d displays a significant effect of WBVT on the total body BMD in children with ND ($p=.22$, $z = 1.24$), SMD (95% CI) = 0.14 (-0.08, 0.37), the heterogeneity was not detected across the studies ($p=.92$, $I^2 = 0.0\%$).

Sensitivity analysis

Despite the undetected heterogeneity across all the studies, the sensitivity analysis was still carried out to ensure the stability and accuracy of the meta-analysis findings. The analysis model was adjusted

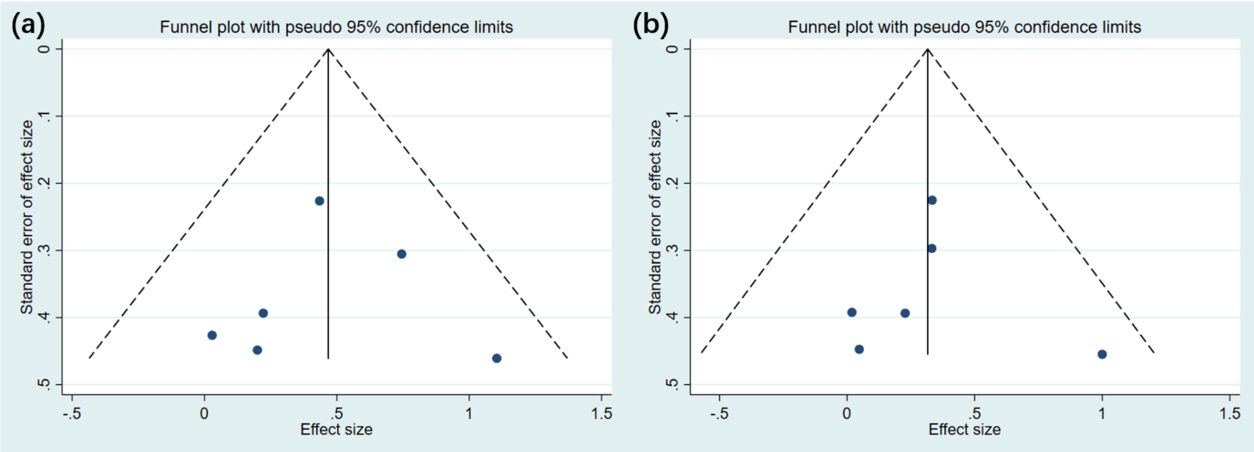

Figure 6. Funnel plot of the publication bias for the (a) femur and (b) lumbar spine BMD based on the WBVT.

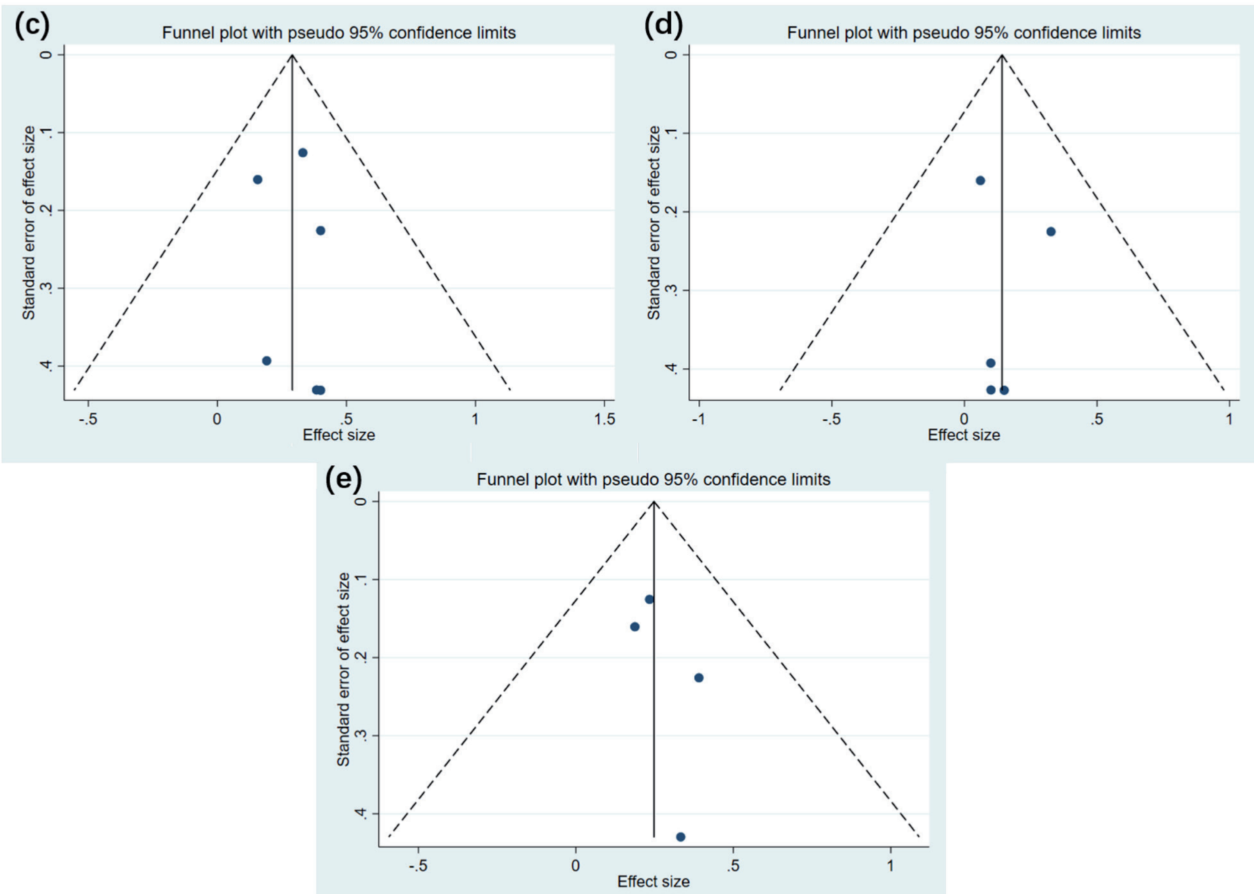

Figure 7. Funnel plot of the publication bias for the (c) total body BMC, (d) total body BMD, and (e) lean mass based on the WBVT.

by removing specific studies and selecting the effect size only. According to the results, each of the selected studies recorded a high level of agreement with the center line. Moreover, the combined effect size between the BMD and lean mass showed no major association change regardless of the removal of any study, signifying the exceptional stability of this study. Figs. 4a, 4b, 5c, 5d, and 5e illustrate the sensitivity analysis for the femur BMD, lumbar spine BMD, total body BMC, total body BMD, and lean mass, respectively.

Analysis of the publication bias

Due to the fairly small sample size of the WBVT studies on children with ND, the funnel plot analysis was conducted using only the eight selected studies. The overall sample size was also close to the minimum number of samples required for a funnel plot analysis. Nevertheless, the result was considered adequate to represent the publication bias to a certain degree with minimum risks. A recent study also demonstrated the effective use of small sample sizes to evaluate the funnel plot analysis (Lu, Wang, Ding, & Shi, 2020). Figs. 6 and 7 show the funnel plot of the effect of WBVT on the femur and lumbar spine BMD of children with ND.

Discussion and conclusions

The aim of the meta-analysis was to determine the effect of WBVT on BMD and lean mass in children with ND. Eight articles were selected in total. Six of the studies covered the femur BMD, lumbar spine BMD, and total body BMC as the output indicators, while four and five studies utilized the lean mass and total body BMD as the output indicators, respectively. Overall, the findings demonstrated that the WBVT significantly increased the femur BMD, lumbar spine BMD, total body BMC, and lean mass in children with ND. However, the WBVT showed no significant effect on the total body BMD. Thus, the WBVT provides an effective alternative rehabilitation program to improve the treatment conditions of children with ND.

The WBVT has been employed as an alternative rehabilitation program to minimize the defects and movement restrictions among children with disabilities (Leite, et al., 2019). The training approach utilizes a vibrating platform that generates high-frequency mechanical stimuli, which are then transmitted throughout the body of the patient to the loaded bone and activate the sensory receptors (Maher, Williams, Olds, & Lane, 2007). Previously, WBVT was shown to improve bone mass, lean mass, muscle strength, and exercise performance (Eid, 2015; Ibrahim, Eid, & Moawd, 2014; Lee & Chon, 2013). Despite that WBVT has been universally used in clinical practice by physical therapists, the exact efficiency of the training approach on children with ND remains debatable due to the limited methodological quality and precision that were applied in the respective studies (Li, et al., 2022). For instance, a recent study revealed that the effect of WBVT beneficially improved the health-related physical fitness of disabled children (Matute-Llorente, et al., 2014). Nevertheless, the study included low-quality studies, in particular non-RCT studies, while both the meta-analysis and the risk of bias of the included non-RCT studies were not performed. Additionally, the study revealed that the DXA was a reliable index to evaluate body composition with excellent precision and reproducibility. The BMD and lean mass indicators were evaluated via the DXA to enhance the homogeneity of the meta-analysis and examine the effect of WBVT on body composition.

Furthermore, lean mass showed a direct correlation with muscle growth and physical activities (Baptista, et al., 2012). Based on the findings of the present study, the lean mass of children with ND increased significantly following WBVT. The result was in agreement with the results of a recent study (Kruse, Schranz, Svehlik, & Tilp, 2019) that reported a substantial thickness increment of *musculus vastus lateralis* in children with CP following home-based progressive resistance training for eight weeks. Moreover, a number of studies have reported that the muscle mass in children with CP increased following comprehensive vibration-assisted training (Lee & Chon, 2013; Vesey et al., 2020). The physiological principle of the anabolic muscle effect of the vibration-assisted training was associated with the vibrational stimulation of the muscle spindles, which led to repetitive muscle contractions and training (Lebedev & Polyakov, 1992; Ritzmann, Kramer, Gruber, Gollhofer, & Taube, 2010). In contrast, a recent meta-analysis study (Saquetto, et al., 2015) demonstrated an insignificant difference between the muscle strength of WBVT and that of the control group, which could be due to the dissimilar indicators or test approaches. The muscle strength comparison ($p=.06$) was also close to the critical significant value, which could potentially represent false negative values due to the small sample size ($n = 3$).

Another study revealed that bone fragility in patients with ND, particularly among children, was associated with an increase in the rate of fragility fractures (Martínez de Zabarte Fernández, Ros Arnal, Peña Segura, García Romero, & Rodríguez Martínez, 2020). The WBVT was shown to significantly improve the femur BMD, lumbar spine BMD, and total body BMC in children with ND. Although the findings in the present study were correlated with that of a recent meta-analysis study related to the effect of WBVT on BMD and lean mass of children with motor disabilities (Li, et al., 2022), the WBVT did not affect the lumbar spine BMD.

It was speculated that the different populations in both studies resulted in the varying outcome. The findings in the present study were also supported by a case study by Dalen et al. (2012), where the BMC of the lumbar spine and legs in children with CP increased following the WBVT. Furthermore, a previous study utilized a WBVT plate from the same manufacturer as the present study and demonstrated a significant enhancement in the total body BMC and lower limb lean mass (n = 40) (Högler, et al., 2017). Following a 20-week training routine, which comprised three 3-min training sessions four times per week, the participants underwent vibration-assisted training for a total of 720 min at a frequency and amplitude of 20 Hz and 1 mm, respectively. Nevertheless, the study excluded the Z-score evaluation, and no control group was applied to compare the results. Meanwhile, a randomized controlled study was performed to explore the effect of WBVT on BMD in children with CP (n = 20) using a similar WBVT system from the same manufacturer (Ruck, Chabot, & Rauch, 2010). Both the treatment and control groups were subjected to a school physiotherapy program. Following an additional three 3-min training sessions five times per week, the treatment group underwent vibration-assisted physiotherapy training for a total of 737−914 min at a frequency and amplitude of 18 Hz and 4 mm (acceleration of approx. 28 m/s^2), respectively. Based on the results, the additional WBVT session on the treatment group showed no major effect on the distal femur and lumbar spine BMD.

It is crucial to highlight the distinct limitations of this study. Primarily, this study selected only eight studies with inconsistent output units, which is relatively a small sample size. Thus, the SDM was the only appropriate output for comparison purposes. Secondly, different intervention programs were adopted, which include the single WBVT and the combined WBVT with other intervention programs. Lastly, this study performed a single-arm meta-analysis evaluation without preparing a control group for comparison purposes due to the inadequate number of RCT studies. In addition, the study could not elucidate the exact mechanism of the WBVT that led to the increased lean mass and BMD. Thus, further studies are required to provide insights into the enhancement mechanism. It is also recommended for future studies to include a sufficient number of RCT studies so that a control group can be applied to achieve a thorough meta-analysis evaluation. While the present study emphasized the impact of WBVT on children with ND, further studies could potentially focus on comparing the impact of WBVT on other populations with different age groups and specific diseases.

This study demonstrated that WBVT is an effective training approach that significantly improved the femur BMD, lumbar spine BMD, total body BMC, and lean mass in children suffering from ND. The analysis was also considered adequate to represent the publication bias despite the relatively small sample size. Although the WBVT showed an insignificant impact on the total body BMD, the training approach can be considered a complementary treatment prescription for children with ND.

Appendix A

Search strategy

Databases	Search strategy	Result (Approximately)
Scopus	#1: Title-Abs-Key (Whole Body Vibration or Whole-Body Vibration) #2: Title-Abs-Key (“Cerebral Palsy” or “ Down syndrome”) #3: #1 and #2 Limiters—Publication date: 20020101-20230101	4,889 55,752 84
Pubmed	#1: [Title/Abstract] Whole Body Vibration or Whole-Body Vibration #2: [Title/Abstract] “Cerebral Palsy” or “ Down syndrome” #3: #1 and #2 Filters: Publication date from 2001/01/01 to 2023/01/01	2,234 36,098 52
Web of Science	#1: TOPIC: (Whole Body Vibration or Whole-Body Vibration) #2: TOPIC: (“Cerebral Palsy” or “ Down syndrome”) #3: #1 and #2 Refined by: PUBLICATION YEARS: (20230101-20010101) Indexes=SCI-EXPANDED, SSCI, CCR-EXPANDED,	4,963 47,472 109
EBSCO	#1: Abstract: (Whole Body Vibration or Whole-Body Vibration) #2: Abstract: (“Cerebral Palsy” or “ Down syndrome”) #3: #1 and #2 Year: 20010101-20230101	4,631 65,241 98

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Submitted: March 5, 2023
Accepted: May 15, 2023
Published Online First: 23.06.2023.

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