A Review: Effect of Whole Body Vibration on Parkinson Disease

Abstract: Parkinson’s disease is a neurodegenerative disorder that causes trembling in limbs, stiffness of muscles and indicates difficulty in ambulation, balancing and organizing the proper gait. Parkinson’s symptoms gradually start and worsen over time. It is estimated that 10 million people have PD worldwide and clinically it is believed that it may be prevalent in people above 50 years of age. Till now there are no pharmacological remedies for Parkinson’s disease to reverse its symptoms or show any improvements. And those medicines which are prescribed usually trigger the symptoms at later stages. There are some alternatives of treatments, which include whole-body vibration (WBV) and therapeutic techniques to minimize the symptoms of PD. In this respective study, previous 10 years (from 2011 to 2020) of studies are accumulated and analyzed qualitatively to investigate the effectivity of whole-body vibration in Parkinson’s disease patients as a therapeutic treatment. According to some studies, vibration therapies are beneficial in treating PD patients and remarkably show satisfactory results. While, some studies negate the effects of vibrational therapies and stands with pharmacological interventions. Moreover, some reject both point of views and demand more quality data to analyze and conclude the effectiveness both in positive and negative aspects to implement in daily lives to practice vibrational therapies openly.

Keywords: WBV, Vibration Therapy, Parkinson Disease, Effects of VT, Whole-Body Vibration.

INTRODUCTION

Parkinson’s disease (PD) is a complicated, irreversible and debilitating neurodegenerative condition leading to progressive depletion of nigrostriary dopaminergic neurons leading to a loss of motor control (Hirsch, M. A., & Farley, B. G. 2009). PD is composed of motor and non-motor signs and effects. The clinical phase of PD also continues with non-motor signs, and patients are not typically diagnosed at this stage of the disorder. Diagnosis happens when there are strong and noticeable motor signs, such as resting tremor, stiffness, weakened posture reflexes. At a greater point of disease development, they show an impairment due to bradykinesia, fatigue, balance and gait troubles with frequent falling (Chen, J. J. 2010). In addition, the dopaminergic side effects of treatments such as dyskinesia are becoming more troublesome. In comparison, the more disease occurs, the decrease the safety and efficiency of pharmaceutical treatments. In addition, retaining a vital degree of versatility is important in order to prevent home care, lack of control and social interaction.

The cause of PD is unclear and there is no treatment or prevention to date and this disorder mostly affects people over 50 years of age and raises prevalence and occurrence with age. As a result, the ageing of the general global population would lead to a drastic number of individuals living with PD (Dorsey, E. R. et al., 2007). The prevalence of the disease increases rapidly with age, around 17.4 in 100 000 people aged between 50 and 59 years to 93.1 in 100 000 people aged between 70 and 79 years, with either a lifetime chance of contracting the disease of 1.5 percent (De Rijk, M. C. et al., 1995). Medicated and non-medicated treatments are proposed to be able to relieve the effects of PD patients (Pahwa, R., & Lyons, K. E. 2010).
Non-pharmacological therapies are commonly recommended for the control of impairments that do not lead to pharmacological care (Olanow, C. W. et al., 2009). The results of PD vibratory stimulation were first mentioned by the neurophysiologist Jean Marie Charcot in the 19th century. He observed that PD patients had less symptoms while commuting with the train, and assumed in a further phase that these results originated in vibratory sensations that were produced by the train. Various vibrating platforms are currently available that are being used for therapeutic and medicinal uses. However, the frequencies and amplitudes of the vibratory stimuli produced vary according to which various physiological reactions occur. In addition, various results can occur from the number of training sets and their length, as well as time to rest periods, etc. Both these conditions focus largely on the clinical and physical conditions of the patient (Cardinale, M. A. J. W., & Wakeling, J. 2005).

The results of the body’s entire vibration are potentially related to direct and indirect behaviour. The rectory neuromuscular response known as “tonic-vibration-reflex” (TVR) is obviously the best analyzed result of vibratory stimulation. From a practical point of view, the TVR is characterized by a transition of sensations to the muscular tendon system followed by a repeated muscle spindle, which contributes to reflex responses in a further phase. However further experiments have shown that this TVR differs in intensity from one subject to another, which may also explain a wide spectrum of effects on various physiological levels. For e.g: there are also direct influences on neuromuscular level reactions within the neuroendocrine system (Prisby, R. D. et al., 2008).

Whole-body vibration (WBV) approaches have been developed as a new alternative. A limited number of trials have examined the impact of WBV on motor symptoms in PD, with reasonably promising findings in open-label designs. In each scenario, only a set stimulus rate was used and no placebo group was used. It is therefore of fundamental importance to analyse a spectrum of doses (in this case frequencies) in contemplation to optimize possible therapeutic effects.

**METHODOLOGY**

**Search Strategy:**

The search strategy aimed to identify articles providing the Effect of Whole Body Vibration on Parkinson Disease. Research was conducted using certain medical search-engines including: MEDLINE, PubMed, Google Scholar, Archives of physical medicine, Journal of Parkinsonism & Related Disorders and rehabilitation, and Medical-Literature Analysis etc. The keywords used were: Parkinson’s disease, Parkinson’s disease and WBV, WBV and exercises, WBV, vibration-therapy, effects of WBV and effects of WBV on PD. The references list was screened of interested articles to identify any further relevant studies and after that titles were reviewed, abstracts and the full texts to determine their eligibility. Furthermore, several studies were included from all over the world written in English language.

**Data Synthesis:**

About 200 publications were extracted from online databases and 13 studies fulfilled selection criteria and were further evaluated qualitatively. Out of those, 9 studies were moderate to high quality and described the positive effects of WBV in PD patients. Moreover, other 3 showed variations between having no effects and weak effects with respect to mobility, gait, balance and motor symptoms.

**Selection Criteria**

Search criteria used for selection of articles included:

**Inclusion Criteria:**

- Articles from 2011 to 2020 aiming for effects of WBV on PD.
- Articles related to effect of whole body vibration on Parkinson disease.
- Articles related to symptoms, mechanism and risk factors of PD.
- Articles published in English language.
- Articles with keywords PD, WBV, VT or RBV etc will be included.

**Exclusion Criteria:**

- Articles older than 2011.
- Articles not relevant to effect of whole body vibration on Parkinson disease.
- Articles published in other than language.

**Effects of Whole Body Vibration on Parkinson Disease**

Presently, there is no disease modifying medication obtainable for PD, although some drugs are in active consideration and review (e.g: Caffeine, GDNF, KM-819, cetirizone, maltodextrin, Inhibitors of LRRK2 kinase etc). There are major drawbacks of clinical study for disorder modification in Parkinson’s disease. There is also a lack of established biomarkers representing the progression of the condition; thus the modification of the disease can only be determined by delaying the progression of the symptoms. Variability in clinical phenotype and disease progression in PD is likely to reflect different pathogenetic mechanisms that may respond differently to therapeutic approaches. Therefore the proper stratification of patients with a view to ensuring targeted and accurate care could be central to the effectiveness of disease-modifying therapy in the future. However, validated and specified standards for the diagnosis of PD clinical subgroups have not yet been developed, although patients can be segregated on genetic criteria. So, before that vibration therapy is being indulged in the treatments of PD and other neurological disorders to be solved or rectified by
different types of vibration therapies including; rWBV, hWBV, simple WBV, targeted BV etc.

So, linking them and finding more about is facts and impacts, following are effects of WBV related to Parkinson’s disease in comparison with different modality perspectives:

- **Conventional Vibration VS Whole-Body Vibration:**

  Rehabilitation treatment, either traditional, WBV or combined, increased functional stability in PD patients. Comparing these variations, there was a greater change relative to traditional therapy, although no distinction was found between conventional and WBV therapy. By considering patients who had missed follow-up in the worst-case scenario study, combination therapy demonstrated better success relative to WBV and traditional therapy. However, there were no variations between groups when removing HY stage III patients from the combined therapy community in the study. This research indicates that a mixture of traditional and WBV therapies can help PD patients the most in terms of functional balance, but a broader sample size of PD patients with stage III HY is required to completely validate and compare variations between group treatments (Guadarrama-Molina, E. et al., 2020).

- **Gait-Velocity, Cadence and Step-Length:**

  It is important to inquire about ambulation in PD patients specifically when considering WBV as a treatment. According to a study, there were no substantial variations in gait velocity, nor did WBV show any significant improvements in cadence, nor did WBV show any significant changes in phase length (Horn, B. et al., 2011). Ambulation is important for the mobility of PD patients, but somehow till now WBV has not provided console results to be practiced in therapeutic treatments.

- **Effect of WBV on Mobility and Balance:**

  All in all, there has been no clear consistency with any particular mobility or balance result following WBV in Parkinson’s disease patients. Several experiments found an intra-group effect after WBV. In other words, these tests demonstrated a positive, beneficial effect after WBV relative to pre-test measurements. Three experiments have shown this effect on mobility and equilibrium, while one study has shown this effect on mobility and two studies have shown this effect on balance. The interaction effect was reported in three experiments. In other words, these experiments demonstrated a more beneficial effect after WBV relative to the control intervention. Two of these experiments used no regulation of therapy where the patients had just slept and one study used a sham controller (A sham control is generally described as a treatment or procedure that is conducted as a control and is equivalent, but omits a main clinical feature of the treatment or procedure under investigation Guadarrama-Molina, E. et al., 2020). The other research found no association effect comparing WBV with either placebo or successful therapy (Sharififar, S. et al., 2014).

- **Safety and Adverse Effects:**

  Protection should be taken into account as earlier research has shown that workplace exposure to WBV is linked to vestibular problems, low-back pain and circulation disturbances (Pozo-Cruz, B. D. et al., 2012).

  Health risks of vibration penetration were first reported about 100 years ago through a health survey performed by pneumatic machine tool operators. Hand vibration damage involves a vascular portion characterized by fragmented bleeding and a neural component characterized by diminished proprioception and agility (Mansfield, N. J. 2004). Vibration sensitivity was also linked with an increased incidence of low back pain for drivers (Bovenzi, M. et al., 2006). Since vibration is known as an occupational hazard, legal exposure restrictions have been enforced in many countries. It is necessary to balance the possible consequences of severe side effects on the neurological and vascular systems with positive advantages when developing a full body vibration training protocol.

  Vibration mode involves higher magnitude of vertical vibration found in devices initially designed for athlete preparation and plates that alternately tilt along an axis to lift limbs (Rubin, C. et al., 2004). Vibration frequencies observed in elderly adults ranged from 12.6 to 60 Hz, with recorded amplitudes ranging from 55 μm to 8 mm, while frequencies at the lower end of this spectrum, especially in combination with amplitudes >0.5 mm, have been identified to create higher peak accelerations in the body than in the medium and cause pain (Kiiski, J. et al., 2008). Many approaches have been incremental, with increased duration, frequency or intensity of vibration.

- **Invigorating Effects:**

  The contributory factors of vibration entail enhanced bone health and neuromuscular functioning and increased bone mineral density in the femoral neck (Kiiski, J. et al., 2008; Gusi, N. et al., 2006; & Rees, S. S. et al., 2008)\(^\text{13,16,17}\). In some, but not all cases, vibration training greatly increased muscle torque and strength as well. Enhancements in muscle function were proportionately highest in plantar flexion and to a minor extent, in knee extension (Verschuuren, S. M. et al., 2004), with hip extension/flexion, knee dorsiflexion and flexion remained unchanged. The neuromuscular benefits of vibration therapy is slightly higher than those of resistance trainings (Kiiski, J. et al., 2008; Gusi, N. et al., 2006). WBV practices have increased gait, mobility and stability in steps that were historically linked to the fall risk (Kiiski, J. et al., 2008; Verschuuren, S. M. et al., 2004). While there is no
improving movement control without adverse effects, such as physical therapy and exercises, have been investigated. The literature clearly supports the efficacious use of such approaches as adjuncts to traditional treatment, specifically related to quality of life, locomotion, balance, and strength.

Moreover, some studies support bodily cell growth through vibration but in the qualitative analysis, it is believed that excessive vibrational doses may aid in denaturing the structure of cells as an individual. Furthermore, WBV should be not recommended to older people of age 40 years, because in this meantime a person is indulged in several diseases such as osteoporosis, menopause and such diseases make the bones extremely fragile and using vibrations will ultimately impose bad effects on bones. WBV therapeutic techniques are recommended to young individuals from the age 25 to 35 years as the muscular tone and toughness is fair enough to oppose the vibrational waves deploying towards the bone structures.

It is also suggested that vibrations should be avoided on the chest and abdominal regions due to sensitivity to organs in human body. For instance, WBV or rWBV on chest may affect the heart-beat or vibration on abdomen area might disturb the digestive system gradually.

RESULTS

WBV exercises are highly applicable in the development of therapeutic procedures for the treatment. As opting the oscillating surfaces with WBV showed positive clinical outputs in PD patients.

Due to the inability of medications to enhance posture equilibrium in PD, the development of non-medicated therapeutic interventions is justified in order to compensate for posture dysfunction and minimize their continuation. The treatment of WBV may help to maintain postural stability and in turn also may enable a physically active way of life. This is an important goal in therapy, as mobility impairment is the major risk factor of falls.

Based on the results, one can speculate about an additional device in physical therapy for PD patients. Future research needs to evaluate long term treatment adaptations, but it is difficult to speculate about long term effects since WBV training as well as medication have an influence on symptoms and PD is characterized by a high heterogeneity in progression. Moreover, further research studies are essential to provide further evidences and possibly reveal further benefits or risks of vibration training for older people.

Whole body vibration (WBV) training has emerged as an alternative and effective method which allows greater short term improvement in strength and balance.
with less time of application. No impairments in static balance were found after an acute bout of whole body vibration at low frequency in a patient with PD, consequently, whole body vibration may be considered as a safe application in individuals with PD.

To give a literary insight, following is a comprehensive table for key conclusions of previous several studies dispensing the effects of WBV (whole-body vibration) effects on Parkinson’s disease patients:

**Table 1**: Detailed elaboration of previous 10 years studies providing the extracted data of effects of WBV on Parkinson’s disease patients.

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<th>Year</th>
<th>Key Conclusions</th>
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| 2020 | WBV therapy is a beneficial method and an alternative for traditional therapies. The combination of both therapies is a major clinical option for improving functional coordination in PD patients as compared to traditional therapy alone (Guadarrama-Molina, E. *et al.*, 2020). Comprehensive examination of cells by time-lapse image analysis showed that vibrations can promote cell growth as an early effect, but can negatively affect cell adhesion and growth profile after many passages as a delayed effect (Kanie, K. *et al.*, 2019). There is no conclusive proof of a PD symptom-reducing effect including motor, balance, gait, and mobility symptoms concerning WBV therapy as compared to the respective control conditions. Only a few studies have analyzed group differences in mobility and motor symptoms. Thus, the implications of vibration therapy on PD remain marginally ambiguous (Yamagami, T. 2018). The findings of this analysis have reports to be forwarded to the PT clinical practice. It is best to follow a multimodal treatment strategy when dealing with people with PD. It was particularly important with the development of PD due to its variable appearance in individuals and the degree of symptoms varies on an independent scale. When treating particular deficits using task-specific strategies, it is best to evaluate the result that is consistent with the output at issue if the therapy produces significant positive progress (Horn, B. *et al.*, 2011). The variation of recovery and time span (less than one year of drug-free therapy) provided evidence to re-instituting of tensigrity can lead to positive changes in motor functions (Jöbges, M. *et al.*, 2004). In most of the subjects, after 12 months of WBV, it showed improvement in motor abilities. It can be concluded that this is in PD patients with WBV therapy that can supplement standard prescriptions (Vucolova, L. 2016). In most subjects, mainly women, ADL score and well-being increased after year of WBV therapy (Karbowniczek, A. *et al.*, 2016). The study indicate that prolonged vibration is a frequent trigger factor for early onset of PD, culminating in worsening movement disorders, progressing to impairment and significantly decreasing the well-being in patients, hampering and making care more difficult (Turgunkhujaev, O. *et al.*, 2016). Moderate, continuous and integrative WBV therapy increases notably the peak performance of the lower limbs in PD patients, although this effect is greatly delayed (about half a year) with respect to the start of treatment (Niewiadomski, W. *et al.*, 2016). WBV has revealed minor but positive effects on the stability and mobility of people with Parkinson’s disease. The effect of various types of equipment and parameters on the diagnostic outcome is undefined but can contribute in conflicting outcomes. Future research on WBV, in particular on how parameters respond to clinical outcomes, could act as a catalyst for broader and more clinically relevant effects backing WBV (Sharififar, S. *et al.*, 2014). There are considerable evidences that single exposure of WBV has good impacts on control, while there is a poor form of evidence that WBV could develop proprioception. Furthermore, with regard to the continuous outcomes of WBV, there is no evidence from reports that enhances control, proprioception, mobility and balance. Yet more analysis on treatment is needed. WBV therapy has resulted in substantial changes in mobility and balance at all frequencies, but not to a higher degree than placebo (Chouza, M. *et al.*, 2011). There is unsatisfactory data to justify or disprove the efficacy of WBV therapy in improving sensorimotor outcomes in individuals with PD. More good quality studies are needed to evaluate the diagnostic accuracy of WBV in the progress of sensorimotor function in PD (Pozo-Cruz, B. D. *et al.*, 2012).
CONCLUSIONS

Parkinson's disease is a neurodegenerative disorder that causes trembling in limbs, stiffness of muscles and indicates difficulty in ambulation, balancing and organizing the proper gait. Parkinson's symptoms gradually starts and worsen over time. Is is estimated that 10 million people have PD worldwide and clinically it is believed that it may be prevalent in above 50 years of age. Till now there no pharmacological remedies for Parkinson's disease to reverse it symptoms or shows any improvements. And those medicines which are prescribed usually trigger the symptoms at later stages.

Abbreviations:
Following are the abbreviations used in above literature:

<table>
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<tr>
<th>VT</th>
<th>Vibration Therapy</th>
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<tr>
<td>WBV</td>
<td>Whole-Body Vibration</td>
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<tr>
<td>PT</td>
<td>Physical Therapy</td>
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<tr>
<td>ADLS</td>
<td>Activities of Daily Living</td>
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<tr>
<td>PA</td>
<td>Physical Activities</td>
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<tr>
<td>PD</td>
<td>Parkinson Disease</td>
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<tr>
<td>TVR</td>
<td>Tonic-Vibration-Reflex</td>
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Whereas, whole body vibration (WBV) training has emerged as an alternative and effective method which allows greater short term improvement in strength and balance with less time of application. No impairments in static balance were found after an acute bout of whole body vibration at low frequency in a patient with PD, consequently, whole body vibration may be considered as a safe application in individuals with PD.

Acknowledgments

My work is dedicated to Lady of Light and Purity Fatima (PBUH), the daughter of Prophet Muhammad (PBUH). Whose countless blessing are always there to strengthen me.

REFERENCES


