

# Comparison of Wii Balance Board and force platform (baropodometry) for the evaluation of plantar pressures among healthy subjects

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## ABSTRACT

This study aimed to compare the use of Wii Balance Board® (Nintendo) with a baropodometer (force platform) to evaluate plantar pressure on healthy individuals. We also analysed the reliability of both platforms and found that, in addition to not being able to validate the data between the two platforms, there not was also a good reliability index in either of the two devices.

## 1. INTRODUCTION

The human foot functions as a support base during gait (Fortaleza, 2011), in addition to that, it provides support during static stand and flexibility during transfers and correct body support. A correct foot biomechanical alignment is responsible for keeping body posture and a symmetric distribution of plantar pressure (Castro, 2007; Lafond, 2004).

It is important to think about reliable equipment that analyses plantar pressure, particularly because their influence offers an indicative of how the foot function during gait and static posture. This information is also useful to improve the understanding of possible relationship between plantar pressure and posture on the lower limbs (Vianna, 2006; Orlin, 2000).

Higher and unequal distribution of plantar pressures may be the cause of various diseases and deformities, for example pain in the calcaneal region, one commonly seen problem in clinical practice, which can be triggered, due to various reasons such as inflammation, heel spur, fracture, bursitis (Menz, 2006; Zammit, 2010).

The force platform, or baropodometer, permits an analysis on points that have higher pressure, which is considered the gold standard measurement tool to assess the pressure midpoint. However, its high cost limits the possibilities for its use. As an alternative, a Nintendo Wii Balance Board® (WBB) was validated which presented ICC 0.77-0.89 compared to the regular force platform used on evaluations of plantar pressures.

Therefore, the aim of this study was to investigate the degree of reliability of WBB in comparison to the force platform with the purpose of using it as a means of a cheap assessment tool as well as a reliable tool used as the gold standard technique on a public hospital.

## 2. MATERIALS AND METHODS

The study was composed by six volunteers (male and female) who were workers and students. Inclusion criteria: Independent gait without the use of any assistive device (crutch, walker, cane, etc.); Do not show cognitive impairment. Exclusion criteria: Being pregnant; Having a diagnosis of rheumatoid arthritis; previous history of surgery or trauma in the calcaneal region; Is not undergoing an adjunctive therapy to treat calcaneal region; metabolic or endocrine disorders and have neurological disorders. Participants were informed about the study purpose and after their consent to participate on the study they signed the Informed Consent – IC. The research began with the application of a questionnaire in order to assess whether the individual did fit the eligibility criteria. Subsequently, we used the Mini Mental State Examination (MMSE) to rule out the possibility of individual presenting cognitive impairment and the questionnaire results were evaluated by stabilometric

analysis. The evaluation process was done by a previously trained person, other than the research coordinator, in order to avoid bias on the study results. Next, participants walked through the surface analysis plant. The surface support plant was assessed by measurement of plantar pressures in each foot, with the individual in orthostatic position on a Baropodometer. Participants were encouraged to stay as relaxed as possible with bare feet shoulder-width apart and arms along the body, staring at a fixed point, without visual or auditory stimulation and this acquisition was made during 30 seconds. The same measurement was conducted by measuring the individual in orthostatic position on the Wii Balance Board (Nintendo®), which presents an excellent reproducibility compared the force platform with test-retest reliability (ICC = 0.77 - 0.89). The orthostatic test was performed with the same standing position held at the baropodometer, with a position considered comfortable by the volunteer. In addition, they were told to keep their arms at the hip. The parameter considered was the pressure midpoint. To assess the cognitive ability and communication, we used Mini Mental State Examination (MMSE) where the person who applied the questionnaire was previously trained. This test is the most widely used in the world. The MMSE is composed of questions divided into 7 categories, each of them assess specific cognitive domains: temporal orientation (5 points), location, orientation (5 points), 3 word memorization (3 points), attention and calculation (5 points), remember three words (3 points), language (8 points) and visual constructive capacity (1 point). The score varies from 0 to 30 points. The average application time varies from 5 to 10 minutes. The scale has good internal consistency and test-retest reliability (Brucki, 2003).

### 2.1 Statistical analyses

All statistical analyses were performed using Statistical Package for the social sciences (SPSS Inc. Version 20). The first step was to examine agreement between the two devices by creating a Bland- Altman Plot for the weight discharge for the left and right side. Specifically, this was performed by plotting the differences in weight discharge measures between the two methods against the mean results (Bland and Altman, 1986). A two way, random effects, interclass correlation coefficients (ICC) model was used to assess reliability as well as the within-device test-retest validity and measurement error over the tests. Point estimates of the ICCs were interpreted as follows: excellent (0,75-1,0), modest (0,4-0,74) or poor (0-0,39).

## 3. RESULTS

The sample consisted of 51 participants, including 17 males (33,3%) and 34 females (66,7%) and the mean age was 34,4 years. The results of weight bearing on the left and the right side, mean difference between baropodometer and WBB and the Interclass correlation coefficient (ICC) are presented on Table 1. The Bland-Altman Plots for the weight discharge for the left and right side are provided in Figures 1 and 2.

**Table 1.** Measures during each assessment and reliability.

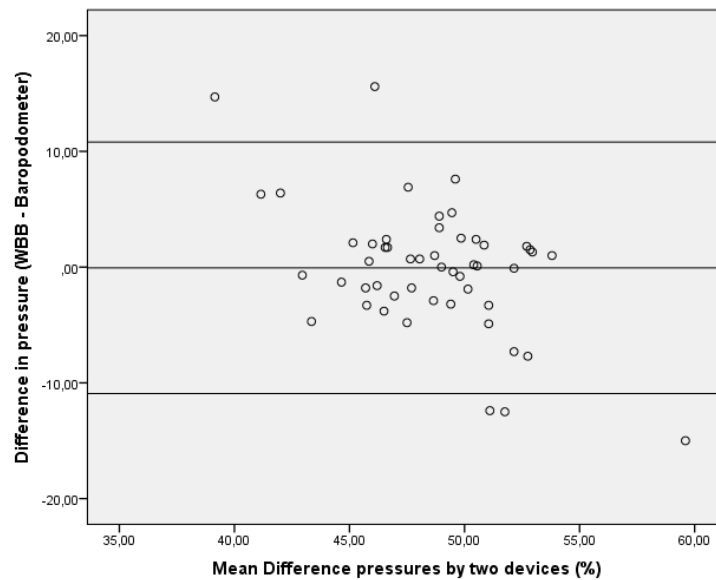
	Baropodometer (Mean (SD))	WBB (Mean (SD))	Mean diff (95%CI)	ICC (95%CI)
Pressure (Right Side)	51,51 (±3,24)	51,27 (±5,62)	0,245 (-1,38, 1,87)	0,347 (-0,154, 0,63)
Pressure (Left Side)	48,54 (±3,21)	48,07 (±4,49)	-0,627 (-1,6225, 1,5)	0,402 (0,056, 0,66)

WBB: Wii Balance Board; SD: Standard deviation; CI: Confidence interval; ICC: Intraclass correlation coefficient; Diff: Difference.

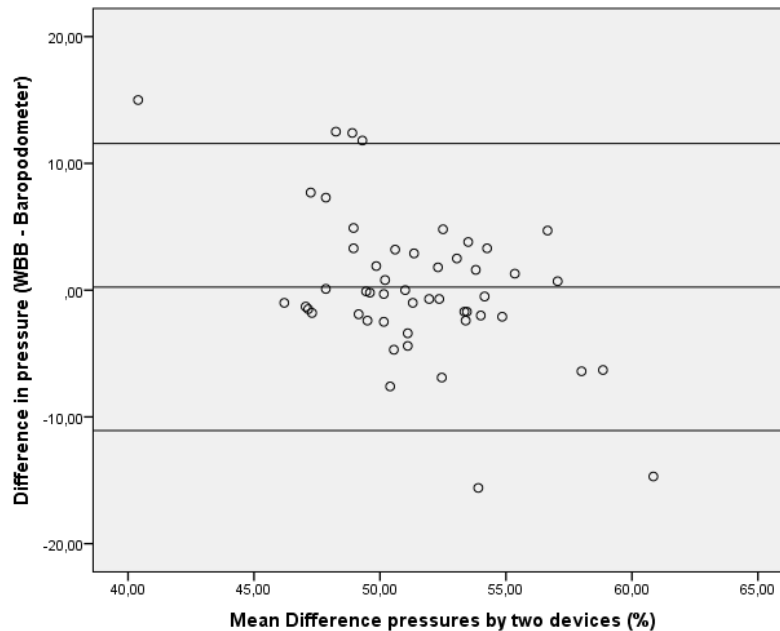
## 4. DISCUSSION

The results of this study show that there was an acceptable reliability rates between the assessments made in the WBB and force platform, corroborating the findings Rebouças et al. in 2013, which compared the use of a force platform with the Biodex Balance System® and found that the comparison between the evaluations of the two platforms also has no statistical significance.

However, the same study, Rebouças et al. say that each platform used by them has its individual reliability, which does not go against described in our study, where we saw that both the force platform as WBB would not have reliability alone, since there is a major discrepancy between analyzes of weight discharges in each leg of a significant number of participants in this research.



**Figure 1.** Bland-Altman plots representing comparisons between the baropodometer and the Wii Balance Board (WBB) for the left side.



**Figure 2.** Bland-Altman plots representing comparisons between the baropodometer and the Wii Balance Board (WBB) for the right side.

In 2008, Cantalino et al. used a force platform and plantígrafo to compare the results of footprints analysis of several individuals, also coming to the conclusion that there was no agreement between the two methods, a finding similar to ours.

We consider it important to emphasize that only use one of several possibilities for evaluating the force platform, which in addition to evaluating plantar pressure orthostatic allows also evaluate plantar pressure dynamic, static and dynamic balance, and other parameters.

In this study, evaluation was performed only once on each platform, which may have a causal factor for the unreliability found individually on the force platform and WBB, distinguished by the method used Rebouças et al., In that each evaluation was repeated 3 times in each of the two platforms used by them. .

## 5. CONCLUSIONS

Given all here above, it is concluded that both the WBB and the strength platform have low levels of reliability when used for pressure rating plant. It is suggested that further studies with more participants and more repetitions of the evaluations are carried out to investigate whether the results presented here may have been influenced by the non-repeat method used here.

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