

Effect of Wii Fit Rehabilitation in Patients with Chronic Ankle Instability: A Review Article

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Abstract

Background: Chronic ankle instability (CAI) is a condition where the ankle repeatedly gives way, creating a persistent feeling of instability and looseness. Risk of falling develops as a result of recurrent injury, documented in 20 to 50% of these cases. Individuals suffering from CAI typically undergo traditional physical therapy protocols aimed at enhancing ROM, muscular strength, proprioceptive awareness, functional ability, and balance.

Aim of Study: Is to review the effect of Wii Fit rehabilitation training on balance, functional ability, and risk of fall in patients with CAI.

Conclusion: Despite the recognized benefits of Wii Fit on health-related outcomes for individuals with CAI, its attractiveness as a method to motivate and engage these patients in higher levels of physical activity, there is still insufficient evidence comparing its efficacy to that of traditional physical therapy programs, which include stretching, strengthening, and proprioceptive balance exercises, in enhancing balance stability, functional ability, and reducing fall risk in individuals with CAI.

Key Words: *Functional ankle instability – Wii fit rehabilitation – Risk of fall – Functional ability – Balance.*

Introduction

CHRONIC ankle instability (CAI) is a condition where the ankle repeatedly gives way, creating a persistent feeling of instability and looseness. Ongoing symptoms of CAI include pain, weakness, and reduced ankle ROM, diminished self-reported functional abilities. If the symptoms last longer than a year post-injury, it is termed CAI [1]. CAI manifests in two primary forms: mechanical ankle

instability (MAI), which involves abnormal looseness in the lateral ankle ligaments, and functional ankle instability (FAI), which involves reduced proprioceptive awareness, impaired neuromuscular control, and balance deficits, with intact ligament integrity [2].

Studies [3,4] indicate that 47% to 74% of individuals who experience lateral ankle sprains will suffer subsequent sprains within 6 to 18 months of the initial injury. Around 30% of these patients progress to CAI [4], characterized by persistent instability symptoms and recurrent ankle sprains lasting over a year [2].

CAI extends beyond the ankle, impacting other joints and leading to additional physical complications [5]. Affected individuals exhibit reduced ankle mobility, secondary tissue damage, limited joint movements, and post-traumatic osteoarthritis. Systemically, CAI hampers proprioception, balance, movement patterns, and causes muscular weakness [5]. A frequent concern among CAI sufferers is the sensation of ankle instability or vulnerability during everyday tasks [6].

CAI management typically involves conservative rehabilitation protocols aimed at enhancing range of motion, strength, proprioception, and neuromuscular control [7]. Wii Fit-based therapy, in contrast to traditional physical therapy, may offer patients more flexible training schedules and diverse, sports-oriented exercises. This approach potentially boosts patient engagement and motivation while potentially reducing healthcare expenses [8].

Unsurprisingly, Wii Fit has become a focal point for physical therapists. The game's distinctive features, combined with the technical attributes of the Wii Balance Board, promote movements in the

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side-to-side and forward-backward planes, mirroring those used in physical rehab protocols [9,10,11]. Wii fit exercise programs have demonstrated effectiveness in enhancing balance among diverse groups, including individuals with Parkinson disease [12], Spastic cerebral palsy [13], older adults [14], Chronic Stroke Patients [15] as well as patients having FAI [16-20] with a limited varying degrees of success. However, these studies only limited to a specific population category; athletic patients or college students with CAI and didn't mention the effect on non-athletic patients with CAI.

Recently there was growing evidence of effectiveness of Wii Fit rehabilitation training as a strategy for improving balance, muscle strength, reduction in fall risk in older adults [21]. The purpose of this review is to evaluate the effectiveness of Wii Fit rehabilitation training in improving balance stability, functional ability and on reducing chances of falls on chronic ankle instability patients.

Clinical impact of Wii Fit exercises on chronic ankle instability management:

Wii Fit exercise mechanism of action:

Wii Fit is an interactive gaming system utilizing a wireless, handheld remote that detects movement. Players mimic their on-screen avatar's actions, performing various physical movements like kicking, punching, jumping, and ducking [22]. As a virtual reality-based product, Wii Fit enhances motivation, trains motor skills, and demands real-time cognitive engagement. By integrating physical and mental tasks, Wii Fit potentially offers cognitive advantages over purely physical activities [23].

Effect of Wii Fit exercises on balance:

Studies concerning Wii Fit's ability to improve balance has reported inconsistent results. Balance enhancements could be attributed to multiple factors: Strengthened lower limb muscles, increased activation of sole tactile receptors and skin/joint mechanoreceptors [24,25], enhanced muscle mechanoreceptor sensitivity (including muscle spindles and Golgi tendon organs) boosting proprioception [26], and the development of more effective postural control techniques [24].

Some studies have shown the effectiveness of Wii Fit in promoting balance control in FAI patients. In 2015 Kim et al. [16] evaluated the impact of 4 weeks of Wii Fit exercises on 20 university students in their twenties with functional ankle instability. The dynamic balance was improved in terms of Biodex Balance System in overall, forward-backward and side-to-side movements relative to the pre-intervention testing. However, the study was limited to its short four-week timeline with participants aged between twenty and twenty-nine.

In 2019, Kim et al. [18] undertook a comparative study of Wii fit exercise and traditional exercise

in 21 college students, who were in their 20s with functional ankle instability. The results have shown that Wii Fit Plus was less effective than traditional exercise methods in improving overall static balance, forward-backward and side-to-side dynamic balance at levels 2, 4, and 8. However, a significant reduction was only observed in specific dynamic balance parameters (overall and forward-backward directions) among the traditional group participants. These findings imply that brief 10-minute balance-strengthening sessions over a four-week period may be insufficient for meaningful balance gains. A more extended program, lasting at least 20 minutes, could potentially produce more favorable balance outcomes.

In 2020, Kim et al. [17] investigated the impact of taping and virtual reality exercises using Nintendo Wii Fit Plus on static and dynamic balance on 21 students. The results revealed the superiority of Nintendo Wii Fit Plus exercise and taping in improving dynamic balance in overall (OA), Anteroposterior (AP), Mediolateral (ML) indices ($p < 0.05$), while it showed statistically insignificant differences in static balance indices (OA, AP, and ML). These results may be due to the inclusion of university students only in the study.

In 2021, Ranjbarzadeh et al. [19] proved the feasibility of an 8-week Wii Fit training program in enhancing static and dynamic balance and performance among 30 athletic males with FAI. The findings showed improvements in static and dynamic balance and performance, as measured by stork and Y balance tests. Further investigations could examine Wii Fit training applications across various demographics and sports to evaluate its injury prevention benefits. In 2012, Vernadakis et al. [27] studied wii fit effect on balance in undergraduate students. The results showed that there were insignificant differences in all stability indices (OA), (AP), (ML) between Wii fit and traditional therapy. The brevity of the training program could account for these results. Sessions consisted of 24 minutes of activity, twice weekly, over an 8-week period. While some variables showed changes, longer study duration might have been beneficial to demonstrate functional improvements.

Effect of Wii Fit exercises on Functional ability:

In 2020, Mohammadi et al. [28] examined the impact of Wii Fit Training on functional ability among fifty male basketball athletes with FAI. The results revealed the improvement in functional ability in the wii fit group compared to the control group. However, the study was limited to short intervention period (four weeks) and young male basketball athletes with FAI. Another comparative study in 2016 by Punt et al. [29] explored the impact of 6 weeks of Wii Fit exercise therapy on ninety lateral ankle sprain patients aged between 18-60 years old. Even though functional ability was improved in all trained groups after 6 weeks of intervention,

wii fit seems to be effective exercise therapy to treat patients with ankle sprain. However, recent study also compared Wii Fit versus traditional training in 54 basketball athletes experiencing FAI. Both training methods demonstrated similar positive impacts on functional abilities, with more favor to wii training. Additionally, Wii training demonstrated improvements in neurocognitive function and can be integrated into rehabilitation protocols for FAI. These findings may be attributed to the limited intervention timeframe (i.e. four weeks), as well as the sample size and population, given that the study focused solely on young male basketball athletes suffering from FAI [30].

Effect of wii Fit exercises on risk of fall:

In 2009, Clark et al. [31] investigated the clinical use of Nintendo Wii™ Bowling Simulation on an elderly female nursing home resident, aged 89, with a history of unspecified balance impairment and repetitive falling. Results showed a reduction in her risk of falling and balance improvement in terms of Berg balance scale and Dynamic Gait index scores (DGI), Time up and go score (TUG). However, it was limited to small sample and the findings may not be applicable to broader patient populations undergoing physical therapy. In 2021, Afridi et al. [32] tried to analyze the available literature to investigate the utility of Wii Fit as a balance-training intervention for older adults, employing different balance and fall risk assessment scales to measure outcomes. From the 312 randomized controlled trials that they assessed, 14 full text articles found that Wii Fit Plus represents a beneficial, economical, easy-to-use, and time-efficient home-based strategy for enhancing balance and physical capabilities in the elderly. This approach effectively reduces fall risks while maintaining a strong safety profile, with minimal to no adverse effects.

In more recent study by Manlapaz et al. [33] conducted on using Nintendo Wii Fit in reducing the falling risk in knee osteoarthritis individuals. Favorable findings were observed in clinical measures including knee muscular strength, balance, fear of falling, and physical function performance. The Nintendo Wii Fit™ represents an effective exergaming platform for reducing fall risk among adults with knee osteoarthritis. However, it was limited to the absence of a control group. In 2018 Morrison et al. [34] conducted a comparative study between balance training and self-directed home-based balance exercises utilizing Wii Fit technology on 65 older adults with type 2 diabetes mellitus. Notably, both interventions led to a substantial reduction in fall risk among this population, which was attributed to enhanced neuromuscular responsiveness, improved sensory awareness in the lower limbs, and favorable alterations in postural stability.

Based on these findings, Wii Fit rehabilitation training (WFRT) can be an appealing alternative

to traditional exercises routines for improving balance, functional abilities and reducing incidence of falling. CAI treatment frequently includes conservative rehabilitation protocols intended to enhance ROM, strength, proprioception, functional capabilities, balance, and neuromuscular coordination. Wii Fit-based rehabilitation therapy offers advantages over traditional physical therapy, including greater scheduling flexibility and a wider range of sports-related exercises. These benefits could potentially lead to reduced healthcare expenses. Wii Fit proved to be effective in enhancing balance among healthy elderly individuals. Consequently, virtual reality training could be recommended as a preventive measure against falls for the elderly [35]. However, the evidence about the impact of Wii Fit on falling risk in patients with CAI is yet insufficient. There is a lack in these studies that supports the using of Wii Fit rehabilitation on controlling risk of fall among non-athletic patients with chronic ankle instability. Therefore, this suggests additive effect of the Wii fit rehabilitation training to the traditional physical therapy program may play beneficial role on improving balance, functional abilities and risk of falling among non-athletic patients with CAI.

Conclusion:

This review's findings propose a potential beneficial impact of Wii Fit on balance, functional abilities, and fall risk outcomes in chronic ankle instability patients. Nevertheless, the limited and diverse nature of available research prevents a conclusive determination of whether Wii Fit rehabilitation can effectively improve balance, functional abilities, and prevent falls, especially in non-athletic individuals with chronic ankle instability.

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تأثير التأهيل بجهاز وى فيت فى مرضى عدم ثبات مفصل الكاحل المزمن: مقال مراجعة

عدم ثبات مفصل الكاحل المزمن هو حالة تتميز بنوبات متكررة من فقدان الكاحل حيث يشعر الكاحل بالارتخاء وعدم الاستقرار. يتطور خطر السقوط نتيجة للإصابة المتكررة، وقد تم توثيقه فى ٢٠ إلى ٥٠٪ من هذه الحالات. غالباً ما يتلقى المرضى الذين يعانون من عدم الاستقرار المزمن فى الكاحل برامج العلاج الطبيعى التقليدية المصممة لتحسين نطاق الحركة والقوة واستقبال الحس العميق والقدرة الوظيفية والتوازن.

الهدف من الدراسة: هو مراجعة تأثير التدريب على إعادة التأهيل لجهاز وى فيت على التوازن والقدرة الوظيفية وخطر السقوط لدى المرضى الذين يعانون من عدم ثبات مفصل الكاحل المزمن.

الخلاصة: على الرغم من التأثير الفسيولوجى الإيجابى لجهاز وى فيت على مقاييس النتائج الصحية لدى مرضى عدم ثبات مفصل الكاحل المزمن حيث أنها تعتبر طريقة جذابة لتشجيعهم وإشراكهم فى مستويات أعلى من النشاط البدنى، إلا أنه لا يزال هناك نقص فى الأدلة على تأثيره مقارنة بتأثير برنامج العلاج الطبيعى التقليدى كتمارين التمدد والتقوية واستقبال الحس العميق فى تحسين استقرار التوازن والقدرة الوظيفية والحد من فرص السقوط لدى المرضى الذين يعانون من عدم ثبات مفصل الكاحل المزمن.

اجريت هذه الدراسة فى العيادة الخارجية للعلاج الطبيعى بمستشفيات جامعة القاهرة ومستشفى المطرية التعليمى فى الفترة من يوليو ٢٠٢٣ إلى ديسمبر ٢٠٢٣.