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Intervention Society

Non Pharmacological Interventions Registry

**Protocol : α Gir+ Intergenerational protocol for gait
rehabilitation to prevent falls and loss of independence in
older adults**

Health Problem : Risk of fall



Bodily

Sheet Code

NPIS-000000031

Designation

Intergenerational protocol for gait rehabilitation to prevent falls and Loss of independence in older adults

Abbreviation

α Gir+

Category

Bodily

Main Health benefit

- The primary goal of the protocol is to prevent the risk of falls and loss of independence among older adults by restoring the complexity of the musculoskeletal system.
- ICD11 : MB47.C

Explanation

The α Gir+ protocol is based on interpersonal walking training, specifically designed to restore the complexity of the locomotor system in older adults, as a loss of this complexity is associated with an increased risk of falls (Hausdorff et al., 1997; 2007).

This program employs an arm-in-arm walking mode between a senior and a younger guide. This configuration allows for a stable mechanical coupling, enhancing step synchronization and promoting a complexity-matching effect (Almurad et al., 2018).

From a theoretical perspective, this protocol is based on the complexity matching model (West, Geneston & Grigolini, 2008), according to which two interacting complex systems tend to harmonize their levels of complexity. The work of Mahmoodi et al. (2020) demonstrated that in this process, it is the more complex system (the young guide) that acts as an attractor and leads to an increase in the complexity of the deficient system (the senior).

Each session includes 4 sequences of walking arm-in-arm with intentional step synchronization. When this protocol is repeated 3 times a week for 3 weeks, we observe a gradual and sustained restoration of walking complexity, measurable during independent walking (solo sequences) and even 2 months after the protocol. This improvement is accompanied by clinical benefits observed in balance, endurance, self-confidence (FES-I), and overall motor performance (Ezzina et al., 2021; Ezzina et al., 2025).

Routine Test

- FES-I Questionnaire
- Handgrip Strength Test
- 6-Minute Walk Test
- TuGo Test
- Single-Leg Balance Test
- SPPB Test

Threshold

Our study did not rely on predefined individual clinical change thresholds, but rather on a statistical assessment of the significance of the effects observed in the experimental group compared to a control group. The analyses (multivariate ANOVA) revealed significant post-intervention differences on several indicators (α -DFA score, FES-I, grip strength), confirming an overall effect of the protocol. However, no individual clinical thresholds have been validated at this stage.

Minimal Clinically Important Change

Our study did not rely on predefined individual thresholds for clinical change, but rather on a statistical analysis of the significance of effects in the experimental group compared to the control group. In the literature, approximate thresholds for clinically significant change are suggested for certain tests in the elderly population, including:

- A change of approximately 5 to 6 kg in handgrip strength,
- A change of approximately 15 to 18 meters in the 6-minute walk test,
- A change of approximately 1 second in the Timed Up and Go test,
- An improvement of ≥ 5 seconds in the single-leg stance test (eyes open) is likely to reflect actual functional improvement,
- A change of approximately 1 point on the total SPPB score,
- For the FES-I questionnaire, a score between 16 and 22 corresponds to a low fear of falling, whereas a score of ≥ 23 points indicates a high fear of falling.

However, these values have not been universally validated as individual thresholds applicable in all clinical contexts. Consequently, results should be interpreted with caution and as part of a comprehensive functional assessment.

Secondary benefits

Our study demonstrated a significant improvement in handgrip strength within the experimental group. This parameter is a recognized indicator of overall health, reflecting muscle function, nutritional status, and physiological reserve. Numerous studies have shown that low grip strength is associated with an increased risk of morbidity, functional dependence, and mortality in older adults. Thus, the improvement observed in this test could reflect not only an increase in muscle performance but also a favorable change in overall health status and long-term prognosis.

Direct Risks

The protocol involves performing walking sequences at a normal pace. In addition, older adults walk arm-in-arm with a young guide. Consequently, the direct risks are low and consist mainly of possible mild muscle fatigue, as well as a minimal risk of falling or injury during functional tests. Appropriate safety measures, including continuous monitoring and individualized adjustment of walking speed, are implemented to minimize these risks.

Risks of interaction

None observed to date.

Biological and Psychosocial Mechanisms

As we age, the body's functional reserve capacity gradually declines, leading to difficulties in adaptation. From a mathematical perspective, the human body can be viewed as a complex system—that is, one with stable and adaptive properties that can be measured through the signals it generates (e.g., gait, heart rate). The theory of complex systems now constitutes a fundamental and original theoretical approach to living organisms. In this theoretical field, complexity is defined by the coordination of multiple interacting components (Whitacre, 2010). Complex systems exhibit essential constitutive properties (redundancy, degeneracy) that ensure the robustness and flexibility necessary for their adaptability and sustainability (Edelman and Gally, 2001). Indeed, it has been shown that young, healthy subjects are characterized by an optimal level of complexity, in contrast to older and/or pathological subjects, in whom we observe a significant loss of complexity (Blaszyk and Klonowski 2001; Goldberger et al., 2002; Gildea and Hancock, 2007). Furthermore, several studies have demonstrated a correlation between advancing age and a loss of complexity in the walking task (Hausdorff et al., 1997; Almurad et al., 2018). Furthermore, Hausdorff's team (1997) suggested a correlation between a loss of complexity in gait and a tendency to fall among older adults.

Our work over the past few years has aimed to restore the complexity of the locomotor system in older adults (who exhibit reduced complexity). We based our work on the complexity matching model (West, Geneston & Grigolini, 2008). The original model suggested that two complex systems maximize their information exchange when they possess similar levels of complexity. Marmelat and Delignières (2012) expanded on this property by assuming that two interacting systems tend to harmonize their complexities in order to optimize their exchanges. This proposal paves the way for studying synchronization between a system of optimal complexity and a deficient system of lower complexity. Almurad et al. (2018), in an initial experiment on the restoration of complexity, put forward the hypothesis that the more complex system is intrinsically more stable than

the deficient system should, in the process of harmonization, encourage the deficient system to increase its complexity. Two years later, this hypothesis was formally demonstrated by Mahmoodi et al. (2020), who showed that when two systems of different complexities interacted, the more complex system did indeed draw the less complex system toward it, resulting in an increase in the latter's complexity.

Specifically, the protocol involves paired walking between an older adult with impaired locomotor complexity and a young, healthy guide. The intervention consists of synchronizing the steps of the two walkers to promote a phenomenon of complexity matching. In this context of motor interaction, the older adult's locomotor system is exposed to a walking signal with an optimal level of complexity. In accordance with the complexity matching model, the interaction between the two systems gradually leads to a harmonization of their dynamics, with the more complex system drawing the less complex system toward it.

From a functional perspective, this interaction results in an immediate increase in the complexity of gait in older adults as early as the initial stages of synchronization. Analyses of step temporal variability indeed show an instantaneous enhancement of locomotor dynamics when older adults walk in sync with the guide. During the training protocol (approximately three weeks), this repeated stimulation of the locomotor system allows for a gradual restoration of gait complexity. Thus, after the intervention period, older adults exhibit significantly higher complexity even during independent walking, approaching the levels observed in healthy young adults.

Responding population

Any older adult who:

- Is over 60 years of age,
- Is independent (GIR 5 and 6),
- Can walk continuously for 15 minutes,
- Is able to understand the protocol instructions,
- Has no contraindications to physical activity,
- Has no neurological or cardiovascular disorders.

Nonresponding population

- Presence of medical contraindications to participating in adapted physical activity, such as: uncontrolled cardiovascular disease, severe musculoskeletal disorders that limit walking, or any medical condition deemed incompatible with participation in the protocol by a healthcare professional.

- Advanced cognitive impairments preventing the participant from understanding or following the protocol instructions.
- Gait and balance disorders.

Participants

Individual and group

Minimum : 1

Maximum : 6

Duration

3 weeks, with 3 sessions per week. Each session consists of 4 15-minute walking intervals separated by 10- to 15-minute rest periods.

Sessions per week

3 sessions: Monday, Wednesday, and Friday

Procedure

The protocol must be conducted on flat, safe ground that allows for continuous 15-minute walking sequences (without stopping to change direction). Examples include parks, sports fields, and sidewalks. Before starting the protocol, the assessment battery is administered (handgrip strength test, FES-I, etc.). All walking sequences must be performed in pairs, following specific instructions: the participant walks arm-in-arm with a younger guide, synchronizing their steps with those of their companion (the younger person). The young guide must walk as naturally as possible, simply adjusting their walking speed to suit the senior's needs. At the end of the protocol (1 to 3 days after the last session), the assessment battery is administered to allow for a comparison between pre-protocol and post-protocol data.

Components

After the guide welcomes the participant, the guidelines are reviewed: walking arm-in-arm (choose either the right or left arm), walking continuously without stopping (so no use of phones, smartwatches, etc.). Then the walking sessions can begin.

Equipment

- The guide will use a stopwatch or timer.
- Appropriate walking shoes.

Location

Flat terrain suitable for walking for 15 minutes without stopping or making any sudden changes in direction (sports field, park, etc.).

Best implementation practices

Choose a pleasant and safe location to help keep participants motivated. The guide should be able to interact with the senior to build trust and make these walks more enjoyable for the pair.

Take breaks (or even extend them if necessary) to ensure the participant's safety.

Best practices for sustainability

To date, no program has been able to ensure the long-term sustainability of the effects observed following the implementation of the protocol.

Our recent work (Ezzina et al., 2025) has shown that the benefits persist significantly for up to two months after the intervention. A complementary study, currently being finalized, suggests that the effects are partially maintained for up to four months after the protocol, although there is a trend toward gradual decline.

These results indicate that repeating the protocol at regular intervals, particularly starting in the second month, could be beneficial for maintaining and prolonging the observed effects over time.

Precautions

It is recommended that, before the intervention begins, a detailed participation schedule be established covering the entire three-week program, including the dates for pre- and

post-intervention assessments. This initial planning helps ensure greater participant engagement, reduces the risk of absenteeism or forgetfulness, and guarantees better continuity in the program's implementation.

If the program is held outdoors, it is important to have a backup location to ensure that sessions can take place regardless of weather conditions.

Finally, having participants sign an information and/or commitment form can help strengthen their involvement and ensure their regular participation.

Regulatory specification

No special measures.

Main Initiator

Samar EZZINA

Qualification required

Anyone trained for the intervention. The training program consists of two levels:

Level 1: "Mentor," is designed to help young guides gain a clear understanding of the protocol, its requirements, and key considerations, as well as to provide them with the necessary guidelines to ensure its proper implementation.

Level 2: "Organization", is designed for organizations wishing to implement the program, providing support with logistical planning, project organization, and the acquisition of basic skills in evaluation and monitoring of the rollout.

Regarding the profile of the facilitator, we ideally recommend a person between the ages of 20 and 50, in good general health, and without any specific impairments or difficulties related to the musculoskeletal system, in order to ensure the safety and quality of the protocol's implementation.

References

Interventional studies

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Other publications

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