Study Design

This study was designed as a randomized controlled experimental trial. The aim of the study was to comparatively evaluate the effects of a functional lower extremity exercise program and neuromuscular electrical nerve stimulation (NMES) on muscle strength, muscle thickness, walking performance, and fall risk in elderly individuals.

Research Setting and Duration
The study will be conducted at the Galatasaraylılar Foundation Nursing Home and in the participants' home environments. The total duration of the study is 10 months, with participant recruitment, implementation, and evaluation phases spread over this period. Following ethics committee approval, the implementation period will begin in November 2025.

Sampling and Randomization
A power analysis performed using G*Power 3.1. 9.7 software identified 42 participants with an 80% confidence interval. Participants will be randomly assigned to two groups (1:1 ratio) provided that they meet the inclusion criteria: - Group 1: Functional lower extremity exercise program - Group 2: Neuromuscular electrical stimulation (NMES) program Randomization will be performed using OpenEpi software.

Application Protocols
1. Functional Exercise Group: - 2 days a week, 12 weeks in total. - Session duration: 40 minutes (5 minutes warm-up, 30 minutes exercise, 5 minutes cool-down). - Exercises: Sit-to-stand from a chair, stepping forward and backward, climbing stairs, semi-squatting, heel rises, etc. - Thera-Band resistance exercises are added in weeks 9–12 (yellow–red–green resistance progression).

2. NMES Group: - 2 days a week, 12 weeks in total. - Application: Bilateral electrode placement on the vastus medialis/lateralis and tibialis anterior muscles. - Parameters: 50 Hz frequency, 300 μs phase duration, symmetrical biphasic waveform, at least 10 contractions per session.

Assessment Parameters
Primary measurements: - Muscle thickness: Ultrasonography (EDAN DUS 60, 7.5 MHz linear probe) - Muscle strength: Lafayette digital dynamometer

Secondary measurements:
- 10-Meter Walking Test - Timed Up and Go (TUG) Test - One-Leg Stand Test - Sit-to-Stand Chair Test - Fall risk with Fullerton Advanced Balance Scale (FAB-T) - Participant satisfaction scale (VAS, 0–10 point range)

Statistical Analysis

All data will be analyzed with SPSS software; appropriate parametric or nonparametric tests (t-test, Mann–Whitney U, ANOVA, etc.) will be used for comparisons between groups. The level of significance will be accepted as $p < 0.05$.

Scientific Quality of the Study

The research directly compares two different non-pharmacological interventions— functional exercise and NMES—for which there are few comparative studies in the literature. In this respect, the study is expected to provide original and clinically important contributions in terms of; - evaluating direct effects on fall risk, - analyzing muscle strength and thickness with quantitative methods, - developing applicable and low-cost methods.

VOLUNTARY INFORMED CONSENT FORM

We invite you to participate in the study titled "Effects of Lower E:trenity Functional E:ercise Progran and Neuronuscular Electrical Nerve Stinulation on Muscle Strength, Thickness, Walking, and Fall Risk in the Elderly." Before deciding whether to participate in this study, you should understand the purpose and nethod of the study, the potential benefits, risks, and disconforts of this study for volunteers, and nake your decision freely within the franework of this infornation. Therefore, it is crucial that you read and understand this forn. This forn contains the written forn of the infornation provided to you verbally by us, as the research directors. Before signing the forn, please take the tine to carefully read the following infornation, which was also provided to you verbally. If you agree to participate, you will receive a copy of this forn, signed by you and the witness present during the infornation session, for safekeeping. The purpose of this study is: The ain of this study is to e:anine and conpare the effects of a lower e:trenity functional e:ercise progran and neuronuscular electrical nerve stinulation on nuscle thickness, nuscle strength, walking, and fall risk in the elderly. If you participate in the study, you will receive functional lower e:trenity e:ercises and neuronuscular electrical stinulation to increase nuscle strength. Participants in both study groups will participate in a total of 12 weeks of training, two days a week. The e:ercise group will be assigned to functional lower e:trenity e:ercises for a total of 40 ninutes. The electrical stinulation group will receive electric current applied to the lower e:trenity nuscles using disposable personal electrodes for a total of 20 ninutes. Participants who neet the study criteria and volunteer to participate will be adninistered various tests related to nuscle thickness, nuscle strength, balance, and fall status, as well as a satisfaction survey, before and after the 12-week period. If the results of the study indicate that one nethod is nore effective than the other, this nethod will be applied to the participants by the sane physiotherapist using the sane principles for 12 weeks after the study is conpleted.

Participation in the study is entirely voluntary. You have the right not to participate in the study or to withdraw fron the study at any tine after participation. You have the right not to answer any questions you do not wish to answer. We would like to inforn you that you will not be subject to any sanctions or loss of rights in all three cases.

We would also like to state that the relevant articles of the "Personal Data Protection Law" will be taken into account in the study/research to be conducted.

Research Off+cer

(Nane-Surnane-Title-Signature)

VOLUNTARY CONSENT

I have read the infornation section regarding the research whose subject and purpose are stated above and have been inforned first verbally and then in writing by the undersigned. I fully understand the scope and purpose of the study in which I an asked to participate and ny responsibilities as a volunteer. I have had the opportunity to ask and discuss the study and have received satisfactory responses. The potential risks and benefits of the study have also been e:plained to ne verbally. I understand that ny participation in the study is voluntary, that I can withdraw fron the study at any tine, with or without justification, and that I nay be e:cluded fron the study by the researcher regardless of ny wishes.
In these circunstances:
1) I agree to participate in this research voluntarily, without any pressure or coercion (including ny child's/guardian's participation in this study).

2) If necessary, I consent to the access of ny personal infornation to the persons/institutions/organizations specified in the legislation.

3) I consent to the infornation obtained in the study (on the condition that ny identity renains confidential) being used for publication, archiving, and, if necessary, for scientific contribution purposes, being transferred outside our country.

I consent to participate in this research without the need for any further e:planation, without being under any pressure, and with full knowledge.

Volunteer's (In their own handwriting)
Nane-Surnane:
Contact
Date:
Signature:

For Those Under Custody or Guardianship: Parent or Guardian's (In their own handwriting) Nane-Surnane:
Contact:
Date:
Signature:

If the Volunteer has a Language/Connunication Problen:
I have translated all e:planations given to the Volunteer. I read and translated all pages of this forn, which includes the infornation and consent sections, for the volunteer. The infornation I translated was understood and approved by the volunteer.

Translator's Name and Surname:

S+gnature:

Your Rights to Participate in/Withdraw fron the Research and the Researcher's Guarantee of Your Rights Protection

Participation in this research is entirely voluntary. You nay decline participation in the research or withdraw at any tine after it begins. There will be no penalty or loss of any rights you nay have if you refuse to participate, withdraw, or are withdrawn fron the study. You or your legal representative will be notified if new infornation regarding the research topic becones available that nay affect your desire to continue the research.

The results of the research will be used for scientific and educational purposes. All infornation obtained fron you will be used solely for research purposes and will be kept confidential. The confidentiality of your identity, if any, will be naintained even when the research is published.

(If audio, photograph, or video recordings will be used, please specify this here.) Contact

Person(s)

Nane and Surnane: Phone:

This two-page Inforned Consent Forn was prepared in two copies, and one copy was delivered to the volunteer.