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Development and Implementation of a Gender-Sensitive Outpatient Rehabilitation Model for Geriatric Patients: A Prospective Cohort Study

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Annotation: Objective: To develop, implement, and clinically evaluate an outpatient rehabilitation model for geriatric patients that incorporates gender-specific characteristics.

Materials and Methods: The study was conducted in three stages. The first stage involved a geriatric analysis of 1,915 patients using validated assessment tools (MMSE, MoCA, MNA, TUG, Barthel Index, BDI-II, SF-36) to identify cognitive, motor, nutritional, and psycho-emotional impairments. The second stage comprised a structural-clinical evaluation of 247 patients to determine profiles of functional deficits. At the third stage, the proposed model was implemented and validated in two outpatient facilities, with its effectiveness assessed in a cohort of 100 patients using key functional scales.

Results: Clear gender-based differences in the prevalence of functional impairments were identified, justifying the need for a personalized model. Implementation of the model led to statistically significant improvements in cognitive function (MoCA: +2.1±0.4 points, $p<0.01$), physical activity (TUG: –2.8 sec, $p<0.05$), nutritional status (MNA: +2.5 points), and overall quality of life (SF-36). The completion rate of rehabilitation programs increased to 62.1%.

Conclusions: A gender-sensitive approach significantly enhances the effectiveness of outpatient rehabilitation for geriatric patients, ensuring sustained improvements in functional health and quality of life. The developed model is recommended for large-scale implementation in primary healthcare settings.

Keywords: geriatric rehabilitation; gender-specific features; outpatient care; cognitive impairment; functional deficits; assessment scales; quality of life.

Introduction

In the context of global population aging, healthcare systems are increasingly burdened by the growing number of elderly patients affected by multiple functional impairments [1]. Cognitive, motor, nutritional, and psycho-emotional disorders contribute to reduced autonomy, lower quality of life, and rising healthcare and social expenditures [2,3]. Modern approaches to geriatric rehabilitation require not only multidisciplinary strategies but also a consideration of individual characteristics, including sex and age differences, which play a critical role in clinical presentation and response to interventions [4].

Several studies have shown that elderly men and women differ in their vulnerability profiles: women are more likely to experience depression, sarcopenia, and malnutrition, while men more often suffer from cognitive and neuro-somatic disorders [5–7]. However, most existing rehabilitation programs remain generalized and fail to address gender-specific needs, reducing their clinical effectiveness [8].

Outpatient rehabilitation models integrated into primary care are especially relevant, as they support long-term patient management in natural living environments and reduce unnecessary hospitalizations [9,10]. Nevertheless, such models rarely incorporate personalized and gender-sensitive components in real-world practice [11].

Therefore, the aim of this study was to develop and implement a personalized outpatient rehabilitation model for geriatric patients that accounts for gender-specific differences and to assess its clinical and functional effectiveness.

Materials and Methods

The study was conducted in three successive and interrelated stages, each implemented at a distinct clinical base corresponding to its specific objectives.

The **first stage** was retrospective in nature and involved an analysis of archived medical records collected from several outpatient facilities and the Research Institute of Rehabilitation and Sports Medicine. The main goal at this stage was to determine the prevalence and structure of functional impairments among geriatric patients, with a focus on age- and gender-specific differences.

The **second stage** comprised a prospective structural-clinical assessment of patients at the Rehabilitation Research Institute. This stage included a comprehensive evaluation using standardized scales for cognitive, motor, nutritional, and psycho-emotional status, with the aim of identifying patient profiles based on combinations of functional deficits and gender-specific patterns.

The **third stage** involved pilot testing and validation of the proposed gender-sensitive outpatient rehabilitation model. It was carried out at the multidisciplinary clinic of Samarkand State Medical University and the Samarkand City Clinical Hospital No. 1. Clinical and functional effectiveness of the model was evaluated using standardized indicators applied consistently across all stages.

All participants provided written informed consent prior to enrollment. The study protocol was approved by the local ethics committee.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were defined separately for each stage in accordance with the objectives and characteristics of the study population.

At the **first stage** (retrospective), patients aged **45 years and older** with chronic somatic and neurological conditions were included. A mandatory condition was the availability of complete and reliable medical records enabling functional status analysis. Exclusion criteria included incomplete documentation and the presence of terminal-stage oncological diseases.

It is noteworthy that the lower age threshold of 45 years was selected deliberately to identify early signs of functional decline that may precede classical geriatric syndromes. This approach facilitated the exploration of premature aging trends and subclinical deficit accumulation, which is relevant for early prevention and timely rehabilitation.

At the **second stage** (prospective), patients aged **60 years and above** seeking outpatient rehabilitation care were included if they exhibited **two or more significant functional impairments** (cognitive, motor, nutritional, psycho-emotional). Only individuals capable of meaningful interaction with a multidisciplinary team and eligible for scheduled clinical assessment were considered. Exclusion criteria were: acute psychotic disorders, severe dementia, and unstable somatic conditions that contraindicated participation in the rehabilitation process.

At the **third stage**, patients aged **60 years and older** were enrolled following preliminary screening for eligibility in a personalized rehabilitation program. Exclusion criteria included refusal to participate, insufficient motivation, severe communicative barriers, acute infectious conditions, and unstable chronic disease progression.

The staged and criterion-driven approach ensured the representativeness and internal consistency of the study sample.

Assessment Tools

A standardized set of validated instruments was used to assess functional status across cognitive, motor, nutritional, psycho-emotional, and daily functioning domains:

- **Cognitive function** was evaluated using the **Mini-Mental State Examination (MMSE)** and the **Montreal Cognitive Assessment (MoCA)**, which are sensitive to a wide range of cognitive impairments, including mild deficits in memory, attention, and executive functioning [12,13].
- **Psycho-emotional status** was assessed using the **Beck Depression Inventory-II (BDI-II)** to identify the severity of depressive symptoms and their impact on patient motivation [14].
- **Nutritional status** was determined using the **Mini Nutritional Assessment (MNA)**, which incorporates anthropometric data, dietary patterns, self-perception, and clinical signs of malnutrition [15].
- **Motor function and mobility** were evaluated using the **Timed Up and Go (TUG)** test, which measures gait speed and balance during movement, and the **Barthel Index**, which quantifies independence in basic daily activities [16].
- **Quality of life** was assessed using the **Short Form-36 (SF-36)** questionnaire, which measures physical and psychosocial well-being across multiple domains [17].

The use of multidimensional standardized assessment allowed for the accurate identification of risk profiles, tailoring of rehabilitation strategies, and personalization of interventions.

Statistical Analysis

Data were analyzed using **SPSS Statistics software, version 26.0 (IBM Corp., Armonk, NY, USA)**. Descriptive and inferential statistics were applied to compare functional outcomes and assess the effectiveness of the model.

Categorical variables were presented as absolute and relative frequencies (n, %), while continuous variables were expressed as means and standard deviations (M±SD) for normally distributed data or medians with interquartile ranges for non-normal distributions. The Shapiro–Wilk test was used to assess normality.

Between-group comparisons were performed using the **Student's t-test** (for normal distributions and equal variances) or the **Mann–Whitney U test**. In multi-group analyses, **ANOVA** with post hoc tests (Tukey or Games–Howell) was used. Associations between categorical variables were tested using the **chi-square test** or **Fisher's exact test** for small samples.

The effectiveness of the rehabilitation intervention was assessed using **paired t-tests** (for pre-post comparisons) and **Cohen's d** to estimate the effect size for key outcome variables.

A **p-value of <0.05** was considered statistically significant.

Results

During the first stage of the retrospective analysis, summarized data from **1,915 patients** (917 men and 998 women; mean age: 58.9 ± 1.3 years) revealed that the development of functional impairments begins as early as the **45–59 age group**, progressively acquiring a **multidomain character** with advancing age. Pronounced gender differences were identified in the structure of motor, cognitive, nutritional, and psycho-emotional impairments.

Motor deficits were more frequently observed among women at younger age stages, particularly in the form of **dynapenia**, whereas **sarcopenia** was more prominent in middle-aged men. In women, muscle-related impairments exhibited a more uniform age-related progression.

Hypomobility and falls were more common among men aged 65 and older, although the overall prevalence of falls was high in both sexes in the oldest age groups.

Cognitive disorders were diagnosed more frequently in men, including progression to **dementia-level decline**, while **depression** was more common in women—especially among those over 70, where emotional vulnerability peaked.

Nutritional impairments, as measured by MNA, were significantly more prevalent among women, whereas men more often demonstrated a combination of **obesity and sarcopenic features**.

Social vulnerability also showed gender-specific patterns: women more frequently reported **loneliness and isolation**, particularly in the context of sensory deficits. Men, despite comparable rates of visual and hearing impairments, showed **fewer signs of social disconnection**.

Table 1. Prevalence of functional deficits by gender (Stage 1, age ≥45 years)

Functional status	Men (%; age)	Women (%; age)
Dynapenia	31.2 ± 1.9% (55–59); 44.1 ± 2.4% (70+)	53.8 ± 2.3% (55–59)
Sarcopenia	47.9 ± 1.8% (60–64)	34.5 ± 2.0% (60–64); 41.6 ± 2.3% (70–74)
Hypomobility	65.3 ± 3.0% (65–69)	49.1 ± 2.4% (65–69)
Falls	59.2% (75+)	56.7% (75+)
Cognitive impairment	32.4 ± 1.5% (60–64)	26.8 ± 1.5% (60–64)
Depression (BDI)	25.1 ± 1.4% (55–59)	46.7 ± 1.6% (55–59); 59.3 ± 2.1% (70+)
Malnutrition	31.6 ± 2.2% (70–74)	63.7 ± 2.8% (70–74)
Loneliness syndrome	17.6 ± 1.3% (70–74)	44.3 ± 1.7% (70–74)

At the second stage, the study included **247 patients** who underwent comprehensive scale-based assessment. The mean age of the cohort was **69.5 ± 5.6 years**, comprising **135 women (54.7%)** and **112 men (45.3%)**. Structural and clinical analysis revealed clear gender differences in the nature and severity of functional deficits.

A particularly noteworthy finding was the distribution of **cognitive impairments**, assessed using MMSE and MoCA. **Women more frequently exhibited mild cognitive deficits**, as indicated by a higher proportion with MMSE scores <27 (66.67% vs. 47.69% in men). However, the proportion of patients with more severe cognitive impairment (MMSE <24) was comparable between genders: 23.08% in men vs. 22.22% in women. These data suggest that cognitive decline in women tends to be identified at earlier stages, whereas in men, it often manifests later and with greater severity. This is further supported by MoCA scores, where only 45.16% of men had preserved cognitive function compared to 57.89% of women.

Additionally, **men had a significantly higher prevalence of mobility impairment**, as evidenced by elevated TUG-based deficits (63.06% vs. 51.89% in women), reflecting a trend toward hypomobility. This may be attributed to both somatic comorbidity and reduced engagement in daily physical activity.

Women, on the other hand, more frequently experienced **psycho-emotional and nutritional deficits**. The prevalence of **depression (BDI-II)** was higher among women (43.94%) than men (32.08%), and **severe malnutrition** (MNA <17) was found in 26.05% of women versus 18.75% of men. Overall, **nutritional deficiency** (MNA <24) was more widespread in women (52.94%) compared to men (40.63%).

Table 2. Gender-specific prevalence of functional deficits (Stage 2)

Scale	Overall (%)	Men (%)	Women (%)
MMSE <24	22.89	23.08	22.22
MMSE <27	51.81	47.69	66.67
MoCA <26	53.85	54.84	42.11
BDI-II ≥10	40.54	32.08	43.94
MNA <17	22.79	18.75	26.05
MNA <24	47.44	40.63	52.94

TUG impaired	57.60	63.06	51.89
Barthel <80	25.49	24.55	26.60

During the third stage, the gender-sensitive model was implemented and validated at two outpatient facilities. A total of **100 geriatric patients** participated (59 women and 41 men), all of whom underwent individualized rehabilitation programs tailored to gender, age, functional profile, and psycho-emotional status.

Statistically significant improvements were observed across key domains:

- **Cognitive function** (MoCA: +2.1 points; $p<0.01$),
- **Mobility** (TUG: –2.8 seconds; $p<0.05$),
- **Nutritional status** (MNA: +2.5 points; $p<0.01$),
- **Quality of life** (SF-36: improvements across all domains, particularly in physical functioning and social engagement).

The **completion rate** for personalized rehabilitation programs increased to **62.1%**, compared to **36.7%** before model implementation.

Discussion

The findings of this study underscore the importance of incorporating gender differences into the design of outpatient rehabilitation programs for older adults. Based on the analysis of over 1,900 cases and clinical validation of the proposed model, it was established that functional deficits in geriatric patients exhibit a clear gender-specific pattern, necessitating a personalized approach to rehabilitation planning.

In the present study, **women more frequently exhibited signs of malnutrition, depressive symptoms, and limitations in daily functioning**, while **men were more likely to experience cognitive and neuromotor deficits**. These findings align with previous research highlighting sex-related differences in aging phenotypes and response to rehabilitation interventions [18].

The effectiveness of the implemented model was evidenced by **significant improvements in all primary outcome indicators**, particularly in **cognitive and motor function**, which are of high clinical relevance given the elevated risks of cognitive decline and falls in the elderly. Notably, the **rehabilitation program completion rate increased to 62.1%**, indicating improved patient adherence and enhanced organizational efficiency.

A major strength of the model is its **multidisciplinary nature** and the **customization of care pathways** according to patients' sex, age, and functional profiles. This is in line with the principles of **personalized medicine** and complies with current international guidelines for the management of older adults [19,20].

However, several **limitations** should be acknowledged. First, the evaluation was conducted within a single regional healthcare system, which may limit the generalizability of the findings. Second, **long-term post-rehabilitation follow-up** was not performed. Third, despite the use of validated scales, **some subjectivity may have influenced self-reported measures**, potentially affecting the assessment of outcomes.

Despite these limitations, the proposed model demonstrated its **practical effectiveness in real-world outpatient settings** and could serve as a **scalable framework** for broader implementation in other healthcare facilities.

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