

## Resilience and quality of life after upper limb injuries: the role of age within the ICF biopsychosocial model

Sofia Paulina Salvador Espín<sup>1</sup>, Anna Isabel Costales Zavgorodniaya<sup>2,\*</sup>

<sup>1</sup> Sofi Physiotherapy Center, Quito, Ecuador.

<sup>2</sup> University of the Hemispheres, Quito, Ecuador.

### Abstract

**Objective:** To identify age-related differences in resilience and subjective quality of life among patients after upper limb injuries, in the context of personal factors within the International Classification of Functioning, Disability and Health (ICF).

**Method:** A cross-sectional study involved 22 patients from a specialized hand therapy center. The WHO Quality of Life-BREF (WHOQOL-BREF) questionnaire and the Wagnild and Young Resilience Scale (RS) were used. For comparison across three age groups (" $< 24$  years", " $25-40$  years", " $> 40$  years"), the non-parametric Kruskal-Wallis test was applied. Additionally, an analysis of individual items of the RS scale was conducted.

**Results:** Statistically significant differences were found between age groups in the Psychological Health domain ( $p = 0.05$ ). The highest subjective well-being in this area was recorded among patients aged 25–40 years. Trends toward age-related differences were observed in the Physical Health domain (increasing with age) and the Social Relationships domain (peaking in the middle-aged group). Analysis of RS scale items revealed that the most pronounced age differences concerned aspects related to self-reliance.

**Conclusions:** The results indicate a non-linear relationship between age and various aspects of adaptation. Young patients ( $< 24$  years) demonstrate lower levels of psychological well-being and self-reliance. At the same time, the subjective assessment of physical health is higher among older patients. These findings underscore the importance of considering age-related and psychological factors for personalizing rehabilitation programs within the ICF model.

**Keywords:** resilience, quality of life, specialized hand therapy, upper limb injury rehabilitation, ICF.

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### Introduction

The International Classification of Functioning, Disability and Health (ICF), developed by the World Health Organization (WHO), is a conceptual framework for understanding functioning, disability, and health in modern healthcare. This classification offers a biopsychosocial approach, considering the interaction of biological, psychological, social, and environmental factors [1] and serves as a universal standard for collecting, analyzing, and developing health-related policies [2]. However, despite the central role of personal factors in the ICF model, they remain the least formalized and clinically utilized component, particularly in orthopedic rehabilitation.

Injuries to the upper limbs, especially the hand, often lead not only to physical limitations but

also to significant psychological distress, reducing patients' quality of life. An integrative review by Maddison et al. identified a high prevalence of mental disorders among individuals with such injuries: depression is observed in 7–71% of patients, anxiety in 23–71%, and post-traumatic stress disorder in 3–95% [3]. Key risk factors for adverse psychological outcomes are injury severity, chronic pain, limb dysfunction, negative perception of the injured hand, ineffective coping mechanisms, and limited social support. These mental symptoms can persist long-term, although they typically diminish three months post-injury. A systematic review by Ghițan et al. emphasizes the significant psychological impact of complex

\* Corresponding author, e-mail: [annacostales@gmail.com](mailto:annacostales@gmail.com).

Resilience acts as a factor that modifies the impact of injury severity on functional and subjective outcomes.

hand injuries on patients and strongly recommends an interdisciplinary approach combining physical rehabilitation with psychological support to achieve optimal functional and emotional outcomes [4].

In recent decades, an important paradigmatic shift has occurred in psychology: from a model emphasizing risks, trauma, and psychopathology to a preventive model focused on resources, potential, and personal strengths. The central construct of this model became resilience — the ability of an individual to withstand life's adversities, overcome them, and to be positively transformed by them. Resilience is viewed as a dynamic process dependent on the interaction of internal resources (personality traits, cognitive strategies) and external factors (social support, cultural context). It serves a protective function, mitigating the consequences of stress and transforming threats into opportunities for growth [5]. Empirical data confirm that higher levels of resilience are associated with better mental health outcomes post-injury [6], more successful outcomes of orthopedic hand surgeries [7], reduced psychological burden from severe injuries [8], and improved long-term quality of life in elderly patients after trauma [9]. These studies indicate that resilience not only correlates with well-being but also modifies the impact of injury severity on functional and subjective rehabilitation outcomes. It is a key factor influencing the trajectory of recovery.

Quality of life, as defined by the WHO, represents an individual's perception of their position in life in the context of culture, value systems, personal goals, expectations, and interests [10]. This multidimensional concept includes both objective (physical functioning, economic resources) and subjective aspects (emotional well-being, relationship satisfaction) [11]. In the context of upper limb injury rehabilitation, quality of life is an integral indicator, and specialized hand therapy contributes to its improvement by reducing pain, restoring functionality, and facilitating social reintegration [12, 13]. However, the effectiveness of such interventions varies depending on the patient's individual psychological resources, highlighting the need for a personalized approach that considers resilience and age-related characteristics.

The objective of this pilot study is to assess and compare levels of resilience and quality of life among patients who have suffered upper limb injuries and undergone a course of specialized hand therapy, while accounting for age differences within the framework of the ICF biopsychosocial model.

## Methods

### Design and Ethics

The study was conducted as a quantitative, comparative, cross-sectional investigation from October 2023 to April 2024. The procedure adhered to the Helsinki Declaration, the Ethical Principles of Psychologists and Code of Conduct of the American Psychological Association [14], and the Ministry of Health of Ecuador's Code of Ethics. All participants provided informed consent.

### Participants

The sample consisted of 22 patients from a specialized hand therapy center in Quito, Ecuador. Inclusion criteria were: an upper limb injury, completion of a hand therapy course, age over 18 years, and voluntary consent.

### Instruments

1. Wagnild and Young Resilience Scale (RS) — assesses overall resilience and two factors: "Personal Competence" and "Acceptance of Self and Life" [15].
2. World Health Organization Quality of Life-BREF (WHOQOL-BREF) questionnaire — contains 26 questions assessing quality of life across four domains: physical health, psychological health, social relationships, and environment.
3. Clinical Classification Scale for Injury Severity: To stratify injury severity, a clinical classification scale developed by the authors based on commonly accepted criteria for assessing upper limb function was used. It considers characteristics such as neuropathic or dissociative pain, deep sensory loss or severe impairments, complete dysfunction in functional tasks, and the need for an interdisciplinary approach (medical, physical, and occupational therapy, psychology). This scale is based on commonly accepted clinical criteria for upper limb evaluation [16–18] and proposes the following levels:
  - Level 0 — No functional impairment: Full and symmetrical range of motion; absence of pain or sensory disturbances; normal strength and coordination; complete independence in daily functional activities.
  - Level 1 — Mild injury: Mild or intermittent pain; minor limitations in mobility or strength; minimal impairments in fine or repetitive movements; ability to perform daily activities, albeit with compensatory techniques.
  - Level 2 — Moderate injury: Persistent or localized pain, partially interfering; reduced

strength and/or joint range of motion by 25 to 50%; moderate sensory impairments; difficulties performing daily activities without assistance or adaptation; active therapy is required to restore function.

- Level 3 — Severe injury: Pronounced or limiting pain; limitation of movement or strength exceeding 50%; significant sensory impairments; inability to perform basic daily activities without assistance; presence of edema, atrophy, or significant stiffness; possible use of splints, orthoses, or assistive devices.
- Level 4 — Critical or complex injury: Absence of voluntary movement in key segments or the entire limb.

## Data Processing and Analysis

Data were coded and processed in Statgraphics Centurion. Descriptive statistics methods were used. For comparing the three independent age groups (“< 24 years”, “25–40 years”, “> 40 years”) across resilience and quality of life indicators, and, due to non-normal distribution, the non-parametric Kruskal–Wallis H test was applied. The level of statistical significance was set at  $p < 0.05$ .

## Results

### Sociodemographic Characteristics

The sample was divided into three age groups: under 24 years ( $n = 6$ ), 25–40 years ( $n = 7$ ), and over 40 years ( $n = 9$ ). The groups were comparable in terms of gender. The majority of participants had secondary specialized or higher education. Socioeconomic status and marital status varied with age, reflecting expected demographic differences.

### Age-Related Differences in Quality of Life

As shown in Table 2, the only indicator for which statistically significant differences were found between age groups was the Psychological Health domain ( $H = 5.99$ ;  $p = 0.05$ ). The highest median score was recorded in the 25–40 years group (24 points), while it was minimal in the youngest group (18 points).

For the Physical Health ( $p = 0.11$ ) and Social Relationships ( $p = 0.16$ ) domains, differences did not reach the level of statistical significance, although a trend toward higher scores with age was observed. No significant differences or trends were identified for other quality of life indicators.

### Analysis of Resilience Aspects

Within the study, a comparative analysis of responses to items of the Wagnild and Young

Resilience Scale (RS) was conducted. The analysis revealed that the most pronounced age differences concerned items thematically related to self-reliance and confidence in one’s own abilities. Non-parametric analysis of these items showed a statistically significant difference between groups ( $H = 5.82$ ;  $p = 0.05$ ): median values were lower in the under 24 years group (10 points) compared to the 25–40 years and over 40 years groups (12 points each), indicating a lower level of self-reliance among young patients. For other thematic aspects of resilience, such as perseverance or meaningfulness, such distinct differences were not found.

### Summary Effect of Age

Collectively, the obtained data indicate that age-related differences in patients after hand injuries are most pronounced in subjective psychological well-being (quality of life) and in the psychological resource of self-reliance as a psychological component of resilience.

## Discussion and Conclusions

This pilot study revealed several age-related patterns in the subjective quality of life and psychological resources of patients who have suffered upper limb injuries. A key result was the discovery of statistically significant differences in the Psychological Health domain (WHOQOL-BREF), with the highest scores characteristic of the 25–40 years group. This age period, often marked by peak professional and social activity, likely provides greater access to coping resources, goal-setting, and social support, which mitigates the psychological impact of injury [3, 6]. These findings are consistent with studies indicating that psychological well-being depends non-linearly on age and is mediated by current life circumstances and resources [9].

Of particular interest is the differentiated age-related dynamics of other aspects of quality of life. Although indicators for the Physical Health and Social Relationships domains did not reach statistical significance, they show divergent trends. The subjective assessment of physical health increased in older groups, reaching a maximum in patients over 40 years. This result may be explained by the phenomenon of shifting internal evaluation standards: having greater life experience and possibly other concomitant age-related changes, older patients may assess the consequences of injury less critically in comparison to their overall physical condition [11]. At the same time, social relationship scores were highest in the middle-aged group (25–40 years), which likely reflects the peak of social activity and engagement at this age. A slight

| Diagnosis                                                                      | ICD-10  | Injury Severity Level | Time from Injury to Start of Physiotherapy | Surgical Intervention | Conservative Therapy | Duration of Rehabilitation (Sessions) | Dominant Hand | Non-Dominant Hand |
|--------------------------------------------------------------------------------|---------|-----------------------|--------------------------------------------|-----------------------|----------------------|---------------------------------------|---------------|-------------------|
| Injury of multiple flexor muscles and tendons at wrist and hand level          | S66.6   | 4                     | 5 days                                     | ■                     | □                    | 1                                     | ■             | □                 |
| Carpal tunnel syndrome                                                         | G56.0   | 1                     | 3 weeks                                    | □                     | ■                    | 15                                    | ■             | □                 |
| Fracture of lower end of radius                                                | S52.5   | 2                     | 3 days                                     | ■                     | □                    | 20                                    | ■             | □                 |
| Dislocation, sprain and strain of joints and ligaments at wrist and hand level | S63     | 2                     | 5 days                                     | □                     | ■                    | 10                                    | ■             | □                 |
| Contusion of finger(s) without damage to nail                                  | S60.0   | 0                     | 1 day                                      | □                     | ■                    | 5                                     | ■             | □                 |
| Carpal tunnel syndrome of left hand                                            | G56.0   | 2                     | 7 days                                     | □                     | ■                    | 10                                    | ■             | □                 |
| Spontaneous rupture of extensor tendons                                        | M66.2   | 3                     | 1 day                                      | ■                     | □                    | 30                                    | ■             | □                 |
| Traumatic rupture of ligament of wrist and carpus                              | S63.3   | 2                     | 15 days                                    | □                     | ■                    | 10                                    | ■             | □                 |
| Traumatic rupture of ligament of wrist and carpus                              | S63.3   | 2                     | 4 weeks                                    | ■                     | □                    | 15                                    | □             | ■                 |
| Fracture of lower end of radius                                                | S52.5   | 2                     | 6 weeks                                    | □                     | ■                    | 5                                     | ■             | □                 |
| Fracture of shaft of radius                                                    | S52.3   | 0                     | 1 day                                      | □                     | ■                    | 10                                    | ■             | □                 |
| Other instability of joint                                                     | M25.3   | 0                     | 1 day                                      | □                     | ■                    | 10                                    | ■             | □                 |
| Carpal tunnel syndrome                                                         | G56.0   | 2                     | 5 days                                     | □                     | ■                    | 10                                    | ■             | □                 |
| Nonunion of fracture (pseudarthrosis)                                          | M84.1   | 3                     | 5 days                                     | ■                     | □                    | 20                                    | ■             | □                 |
| Fracture of other metacarpal bone                                              | S62.3   | 3                     | 5 days                                     | ■                     | □                    | 20                                    | ■             | □                 |
| Traumatic amputation of finger(s) (partial)                                    | S68.2   | 4                     | 1 day                                      | ■                     | □                    | 40                                    | ■             | □                 |
| Sequelae of fracture at wrist and hand level                                   | T92.2   | 4                     | 1 day                                      | ■                     | □                    | 40                                    | ■             | □                 |
| Carpal tunnel syndrome                                                         | G56.0   | 1                     | 10 days                                    | ■                     | □                    | 20                                    | ■             | □                 |
| Fracture of first metacarpal bone, left hand                                   | S62.2   | 2                     | 3 days                                     | ■                     | □                    | 20                                    | ■             | □                 |
| Other instability of joint                                                     | M25.3   | 3                     | 7 days                                     | ■                     | □                    | 20                                    | ■             | □                 |
| Fracture of shaft of ulna                                                      | S52.2   | 2                     | 7 days                                     | ■                     | □                    | 20                                    | ■             | □                 |
| Malunion of fracture                                                           | M84.0   | 2                     | 1 day                                      | ■                     | □                    | 20                                    | ■             | □                 |
| Fracture of other finger                                                       | S62.6   | 2                     | 1 day                                      | ■                     | □                    | 20                                    | ■             | □                 |
| Ganglion of right wrist                                                        | M67.431 | 1                     | 15 days                                    | ■                     | □                    | 10                                    | □             | ■                 |
| Ganglion of left wrist                                                         | M67.432 | 1                     | 15 days                                    | ■                     | □                    | 15                                    | ■             | □                 |
| Injury of multiple flexor muscles and tendons at wrist and hand level          | S66.6   | 2                     | 1 day                                      | ■                     | □                    | 15                                    | ■             | □                 |
| Stiffness of joint, not elsewhere classified, 4th finger, right hand           | M25.6   | 3                     | 6 weeks                                    | □                     | ■                    | 10                                    | ■             | □                 |
| Fracture of other finger                                                       | S62.6   | 0                     | 5 days                                     | □                     | ■                    | 1                                     | ■             | □                 |

Note: Data are presented in accordance with ICD-10 criteria.

**Table 1. Participating patients' data according to ICD-10 criteria**

| Variables                    | Medians |       |      | Kruskal-Wallis<br>Test Statistic | P-value |
|------------------------------|---------|-------|------|----------------------------------|---------|
|                              | < 24    | 25–40 | > 40 |                                  |         |
| Overall perception of QoL    | 4       | 4     | 5    | 0.86                             | 0.65    |
| Overall perception of health | 3       | 3     | 4    | 3.40                             | 0.18    |
| Physical Health              | 24      | 27    | 28   | 4.44                             | 0.11    |
| Psychological Health         | 18      | 24    | 22   | 5.99                             | 0.05*   |
| Social Relationships         | 31      | 41    | 39.5 | 3.70                             | 0.16    |
| Environment                  | 4       | 4     | 4    | 0.02                             | 0.99    |

\*  $p < 0.05$ . Domain scores (domains 1–4) are presented as points according to the standard WHOQOL-BREF scoring procedure.

**Table 2. Quality of Life Indicators (WHOQOL-BREF) Across Different Age Groups**

decrease in this indicator in the >40 years group may indicate a natural age-related trend towards greater selectivity in social contacts.

Additional analysis of items from the Wagnild and Young Resilience Scale, focused on aspects of self-reliance, also revealed age-related differences. Lower scores on this group of items among patients under 24 years may reflect an age-related feature of developing personal autonomy and confidence in one's own abilities during a crisis caused by injury. Consistently high scores in groups over 25 years are consistent with a model of psychological development suggesting growth in self-reliance and the ability to rely on internal resources with age and experience [5]. It is important to emphasize that other aspects of resilience (e.g., perseverance, meaningfulness) did not show pronounced differences, which may indicate the relative stability of the basic capacity for adaptation in this sample.

A limitation of the study is the small size and clinical heterogeneity of the sample, which precludes generalizing the findings to the broader population and requires caution in interpretation, especially regarding findings that did not reach statistical significance. Nevertheless, the obtained results have important practical significance. They point to the need for a differentiated approach in rehabilitation: for young patients (<24 years), the program can be supplemented with elements aimed at strengthening feelings of self-reliance and psychological support. For middle-aged patients, work on maintaining high social engagement as a recovery resource may be relevant. In the older age group, formed adaptation skills and a realistic assessment of capabilities can be used to personalize rehabilitation.

Conclusions drawn from this pilot study underscore the value of integrating quality of life assessment and specific psychological resources (resilience) into the clinical practice of

rehabilitation. This allows for not only evaluating functional treatment outcomes but also identifying targets for psychosocial intervention within the holistic ICF biopsychosocial model, contributing to the development of more personalized and effective rehabilitation strategies.

## Conclusion

The present study demonstrates the informativeness of assessing resilience and quality of life in patients after upper limb injuries. The results highlight the presence of age-related differences in psychological adaptation and subjective well-being: young patients (<24 years) are characterized by lower levels of self-reliance and psychological health, whereas patients in middle and older age groups exhibit higher values for these indicators. The obtained data justify the need to integrate psychological assessment tools, such as the resilience scale and WHOQOL-BREF, into interdisciplinary rehabilitation practice. This approach allows for identifying key psychological resources and forming personalized recovery strategies, thereby enhancing therapy effectiveness and patients' quality of life.

## Conflict of Interest Statement

The authors declare no conflict of interest. The study did not receive external funding.

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