Effect of a Nurse-Led Rehabilitation Program: A Quasi-Experimental Study Examining Functional Outcomes in Patients With Hand Burns

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Abstract

Purpose: The model of early rehabilitation for people with burns is still relatively novel in developing countries such as Egypt. The study examined the effect of a nurse-led rehabilitation program on functional outcomes in patients with severe hand burns.

Design: A quasi-experimental design was used in this study.

Methods: The study was completed in the burn unit of a teaching university hospital in Alexandria, Egypt, with a convenience sample of 80 patients with severe hand burns. Participants were consecutively assigned to one of two groups: control ($n = 40$), which received only routine hospital care and clinical interventions, or intervention ($n = 40$), which received routine hospital care and clinical interventions and a 4-week nurse-led rehabilitation program (health education including audiovisual aids and burn rehabilitation education booklet, social support, and hand rehabilitation exercises). To assess functional outcomes, both groups were given pre- and posttests of the Disabilities of the Arm, Shoulder and Hand outcome and the Hand Motor Function Observational Checklist questionnaires. Descriptive and inferential statistics were conducted.

Results: Functional outcomes were significantly improved in the intervention participants compared to the control participants ($t = 5.710$, $p < .001$). The differences in index scores between the two groups were statistically significant ($p < .001$).

Clinical Relevance: The study provides information for burn rehabilitation nurses in developing countries to develop and test early interventions that improve functional outcomes in this population.

Conclusions: A 4-week nurse-led program may be a beneficial intervention for improving functional outcomes in adult patients with severe hand burns who are undergoing rehabilitation.

Keywords: Functional outcomes; hand burns; nurse-led rehabilitation program; quasi-experimental.

Introduction

Burns are injuries caused by the application of chemicals, heat, radiation, or electrical current to the body's inner or outer surface, resulting in tissue depletion (Tiwari, 2012). Burn injuries are a significant public health concern worldwide and the fourth most common injury, which can result in high mortality and morbidity (Mamashli et al., 2019). Burns are also the leading cause of disability-adjusted life-years in underdeveloped countries, accounting for 96% of all fire-related deaths (Forbinake et al., 2020). Egypt has the highest rate of burn-related deaths in the world, with approximately 250,000 individuals experiencing severe burns annually and 40% dying (Al-Aees, 2020). As a result, burns are among the most serious medical emergencies in Egypt. Burns may cause activity limitations, environmental barriers, physical impairments, and participation restrictions in the short term, making a return to work difficult on an individual basis, according to the International Classification of Functioning, Disability and Health (Jacobson et al., 2017). Moreover, psychological conditions such as depression, anxiety, sleep disturbance,

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The statistics were checked prior to submission by an expert statistician (S&S for Statistical and Scientific Services, Alexandria, Egypt; Name: Amgad Aly Hamza, e-mail: sscbc2000@yahoo.com).

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and stress-related disorders all contribute to the long-term dysfunction that patients with burns experience (Li et al., 2017; Mamashli et al., 2019; Wiechman et al., 2018).

The hand is essential to human function and a strong predictor of workplace and societal reintegration (Aghajanzade et al., 2019). It is also the most likely body part to be burned, with an 80% severe burn incidence (Aghajanzade et al., 2019; Germann, 2017). More than one third of admissions are adult patients with hand burns that exceeded 23% of total body surface area (TBSA), as determined by burn surgeons in an epidemiological study conducted in Upper Egypt (Taha et al., 2018). Hand burn injuries are generally not critical because of the small surface area of the hands (6% of TBSA), but deep burns may cause severe hypertrophic scar formation, joint contractures or deformities, and motor dysfunctions requiring hospitalization because of the hand's complex and delicate unique anatomical structure (Edger-Lacoursière et al., 2023). Many studies have indicated that hand burn contractures are among the most prevalent, accounting for up to 35% of all contractures (Kraemer et al., 1988; Tiwari, 2012). These hand deformities may affect the functional outcomes and quality of life (QOL) of patients, as well as high healthcare costs because of burn-related scar management (Mamashli et al., 2019; Tang et al., 2015). The American Burn Society indicates that hand burns are classified as major damage, and people who lose hand functionality lose 54% of their overall functionality (Germann, 2017; Perera et al., 2015). Functional outcomes include physical, social, and psychological functions, which may be adversely affected by severe burns. Therefore, effective early rehabilitation programs and interventions for patients with severe hand burns are required.

Technological advances in acute burn care management, including intensive care, aggressive surgical wound care, approaches to wound healing, and scar management, have increased the rate of survival after severe burns (Lotfi et al., 2020). Therefore, the importance of early rehabilitation and interventions for adult patients with burns has grown, and these are now regarded as essential parts of burn management (Aghajanzade et al., 2019; Edger-Lacoursière et al., 2023; Seyedoshohadaee et al., 2022). The goal of burn rehabilitation is to actively prepare patients to return to the desired conditions under all circumstances, as well as to improve the burn area appearance, restore functionality, encourage activities of the burn area, reduce disability, and help patients in understanding the extent of their burn problems (Procter, 2010). Burn nurses work closely with physicians, occupational therapists, and physiotherapists to assess patients' rehabilitation needs, provide total patient care, and coordinate activities with a multidisciplinary team (Lotfi et al., 2020). Patients with severe burns frequently require a lengthy rehabilitation process that begins in an acute care facility, moves to an inpatient rehabilitation center, and is completed in an outpatient setting (Procter, 2010). Tang et al. (2015) also indicates that without early rehabilitation to minimize and prevent scar formation, patients' physical and psychological conditions worsen, negatively impacting their functional outcomes (impaired range of motion [ROM], fine motor function, and activities of daily living [ADL]). Studies on functional outcomes may aid in the evaluation and management of patients undergoing hand burn rehabilitation, as well as monitoring the effectiveness of the rehabilitation programs (Procter, 2010; Tang et al., 2015). However, the effect of hand burn rehabilitation in acute care on functional outcomes has received little attention in the literature. In terms of patient outcomes, Edger-Lacoursière et al. (2023) reported that research on hand burns has not progressed compared with other burn sites. The gaps in clinical practice consensus may be explained by the paucity of high-level evidence in the literature.

Many countries have conducted research on the rehabilitation of patients with moderate-to-severe hand burns, focusing on functional rehabilitation recovery approaches such as scar development mechanisms; operative treatment; the patient's early posture; and the use of various virtual reality, compact disc, video, and rehabilitation devices. These studies have shown that rehabilitation interventions may improve functional outcomes (Edger-Lacoursière et al., 2023; Mamashli et al., 2019; Tang et al., 2015; Yoshida et al., 2022), but such nursing research on patients with severe burns has been limited in developing countries such as Egypt. Only two randomized controlled trials assessing the effects of 5–8-weeks of nursing rehabilitation interventions on functional outcomes in patients with hand burns were found (China and Iran) (Bayuo et al., 2021; Seyedoshohadaee et al., 2022). In addition, burn rehabilitation is still in its early stages in developing countries, with most clinicians and healthcare institutions focusing on medical management rather than rehabilitation (El-Maaytah et al., 2018; Forbinake et al., 2020; Taha et al., 2018).

Furthermore, in developing countries, few rehabilitation centers or hospitals have a fully staffed team of healthcare workers ready to deliver thorough rehabilitation for patients with burns (Bourgi et al., 2020; Forbinake et al., 2020; Taha et al., 2018). Therefore, most patients with burns have severe disabilities because of the lack of a concept of early rehabilitation (Bourgi et al., 2020). According to the findings of Gorbani et al. (2021), increased social support for patients with hand burns would also result in improved adaptation and a better return to life throughout the rehabilitation stage. Considering social support in

rehabilitation programs can help patients avoid undesired physiological complications, improve self-management practices, have a favorable effect on the patient's physical state, and eventually result in better performance (Gorbani et al., 2021; Waqas et al., 2016). However, inadequate data support solid recommendations for effective structure and content for nurse-led rehabilitation interventions related to severe hand burns because of the variety in the duration and structure of these interventions, patients' medical characteristics, and self-report functional outcome tools. Therefore, an assessment of the effectiveness of such nursing programs to enhance functional outcomes in patients with severe hand burns in underdeveloped countries such as Egypt is required. We believe that this study will be a helpful resource for burn nurses because it will provide scientifically validated data to support their clinical reasoning and decision-making regarding severe hand functional outcomes. This study aimed to examine the effect of a nurse-led rehabilitation program on functional outcomes in adult patients with severe hand burns. By comparing pre-intervention Disabilities of the Arm, Shoulder and Hand (DASH) outcome (Hudak et al., 1996) and Hand Motor Function Observational Checklist (HMFOC) scores with post-intervention scores, we evaluated the effect of a nurse-led rehabilitation program on adult patients with severe hand burns.

Methods

The study is reported using the Transparent Reporting of Evaluations With Nonrandomized Designs checklist for a quasi-experimental study (Des Jarlais et al., 2004; see Supplementary File 1, http://links.lww.com/RNJ/A51). This study's protocol was approved by the selected hospital's research ethics review board (Reference No. 2022-9-7).

Study Design, Setting, and Sample

A quasi-experimental study examined a convenience sample of 80 adult patients with severe hand burns recruited from a university teaching hospital in Alexandria, Egypt, from November 2022 to April 2023. In addition to its function in scientific research, this hospital is the major setting among the most prominent university hospitals in the Arab Republic of Egypt, providing a full range of free educational, diagnostic, preventative, rehabilitation, and therapeutic services. The hospital currently has around 2,000 beds in various surgical and medical specialties, as well as a burn unit (30 beds) and outpatient clinics. The burn unit is committed to providing free, high-quality care (dressing, hydrotherapy, ozone therapy, surgical operations, rehabilitation, and follow-up care) to patients with a wide range of burns of varying degrees and percentages. The probability sample method was impossible because of no existing electronic database of people with hand burns in the chosen healthcare setting. However, all eligible patients in the burn unit with severe hand burns were approached to be involved in this study.

The participants were consecutively assigned to the intervention and control groups. We initially enrolled participants in the control group to prevent contamination between groups. The rehabilitation program and the assessment of the intervention group began once the recruitment and evaluation of the control group were finished. Participants in the intervention group (n = 40) received the nurse-led rehabilitation program (Table 1) in addition to routine hospital care and clinical interventions, and the control group (n = 40) received only routine hospital care and clinical interventions. Routine hospital care and clinical interventions, which are given to all patients with severe hand burns, include fluid management, nutritional support, surgical debridement, excision and skin grafting, surgery, medications (analgesia, antianxiety, steroid injections), topical antimicrobial therapy, dressing and wound care, silicone gel, and fundamental medical knowledge from burn nurses in the unit.

Our study included patients who met the following criteria: age of ≥18 years, recent dominant hand burns (whether or not the opposing hand was involved), deep partial-thickness or full-thickness burns (deep second- and third-degree burns), burn size of >20% TBSA (some guidelines for classifying serious burn injuries include >20% TBSA in adults, 10% TBSA in geriatric patients, and 30% TBSA in children; Jeschke et al., 2020) as determined by the burn nurse or surgeon, ability to read and write Arabic, and willingness to participate in this study. The exclusion criteria were severe disorders or upper-limb complications (severe cardiac disorders; spinal cord or traumatic brain injury; malignancy; diabetes mellitus [because of the possibility of sensory and motor neuropathy] or renal failure; serious fracture or motor disorders; severe infection; amputation; and nerve, muscle, skeleton, or tendon damage), mental or psychiatric disorders, and hospitalization for more than 3 days after the burn injuries.

Calculating the sample size based on the main functional outcome measure (DASH outcome questionnaire; Hudak et al., 1996) at a 95% confidence level, 0.5 effect size, and 80% statistical power yielded a total of 60 participants. This effect size was equivalent to that achieved by the research of Seyedoshohadaee et al. (2022) and Li et al. (2017), which demonstrated sufficient power to detect probable changes or effects (more than 60% improvement of DASH or functional outcome scores) over the short duration of nurse-led rehabilitation programs. Given the

Table 1 Contents of a Nurse-Led Rehabilitation Program

Method	Content	Place/Personal
Acute stage (Admission) Days 1–3 2–3 education sessions (each session lasted 30–45 minutes)	• Completion of the sociodemographic, Disabilities of the Arm, Shoulder and Hand (DASH) outcome and Hand Motor Function Observational Checklist (HMFOC) questionnaires.	With help and under the supervision of a trained researcher holding a PhD degree in medical surgical nursing at their private rooms in the hospital
From Week 1 to Week 4 exercise sessions twice daily (each exercise session lasted 10–30 minutes)	• Social support according to age, educational level, ability to learn, and mental and physical conditions (e.g., addressing physical needs, such as personal care, expressing empathy, providing needed information, telling success stories in burn treatment, increasing communication, ensuring positive attitudes). Families of patients were also given targeted health education to boost confidence and understanding of their role in the rehabilitation process. • Individual health education face-to-face sessions. Information on the function and composition of normal skin, burn degrees and sizes, treatment, the wound healing process, edema reduction, hand surgeries and skin grafts, incidental symptoms scar hyperplasia, the body functions following burns, hand common disabilities and rehabilitation exercises, and coping strategies, using audiovisual aids (slides, videos, illustrated pictures, and a hand burn rehabilitation education booklet). • Each participant received the burn rehabilitation education booklet (including information about the program's goals, proper/correct hand position–hand splint, hand rehabilitative exercise practices, ROM, methods to deal with positioning and to improve hand function, and strategies to improve participation in ADL) after the in-person health education sessions, which summarized the outlined contents and included visual materials for future self-education.	Provided by a trained burn nurse with 5 years of experience at this burn unit and who had completed a mandatory burn rehabilitation training program that included theory and practice
	• Individual hand rehabilitation exercise sessions. Week 1: passive hand movements (10–15 minutes). Week 2: passive and active movements were combined and including practice ADLs (30 minutes). Week 3: passive and active movements continued (30 minutes). Week 4: active movement, continuing with the ADLs and included combination of functional hand rehabilitation exercises. The following exercises (based on clinical judgment) were involved but were not restricted to finger and palm pressures, passive and active ROM, positioning (splint if needed), stretching, active resistive, edema reduction, and practicing ADLs such as grasping a rubber ball and a bed bar, writing, closing and opening bottles, buttons and zippers, getting dressed, and using a spoon with the burned hand. • Continue providing social support	Provided by a senior physiotherapist who worked at this burn unit

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Table 1. *(Continued)*

Method	Content	Place/Personal
Rehabilitation stage (1–2 days before discharge)	• Completion of the DASH and HMFOC questionnaires.	Under the supervision of a trained researcher holding a PhD degree in medical surgical nursing at patients' private rooms.

Note. ROM = range of motion; ADL = activities of daily living.

burn care research's reported attrition rate of 20% (Bayuo et al., 2021), an additional six people were recruited for each group, for a total of 36 participants per group. Of the 450 patients selected for participation, 92 met the inclusion criteria, and 80 gave their verbal and written consent (final sample size: 80 participants; see Figure 1).

Measures

The case information survey was used to measure the sociodemographic and medical characteristics of the participants. These included gender, age, marital status, education, residence, job status, cause of burn, degree and depth of burn, first aid, percentage of TBSA, skin graft, and affected joints. The DASH outcome survey was used to assess the primary outcome (functional ability and disability or symptoms), and the HMFOC was used to assess the secondary outcome (hand motor performance).

DASH Outcome Questionnaire

Hudak et al. (1996) developed and validated the 30-item self-administered DASH outcome questionnaire to assess functional status and degree of disability or symptoms in patients with upper-limb musculoskeletal diseases, with an emphasis on the patient's ability to do various upper-extremity activities. It includes the following physical function, social, and symptoms-related domains: the level of difficulty in completing different physical activities as a result of hand, arm, or shoulder problems (21 items);

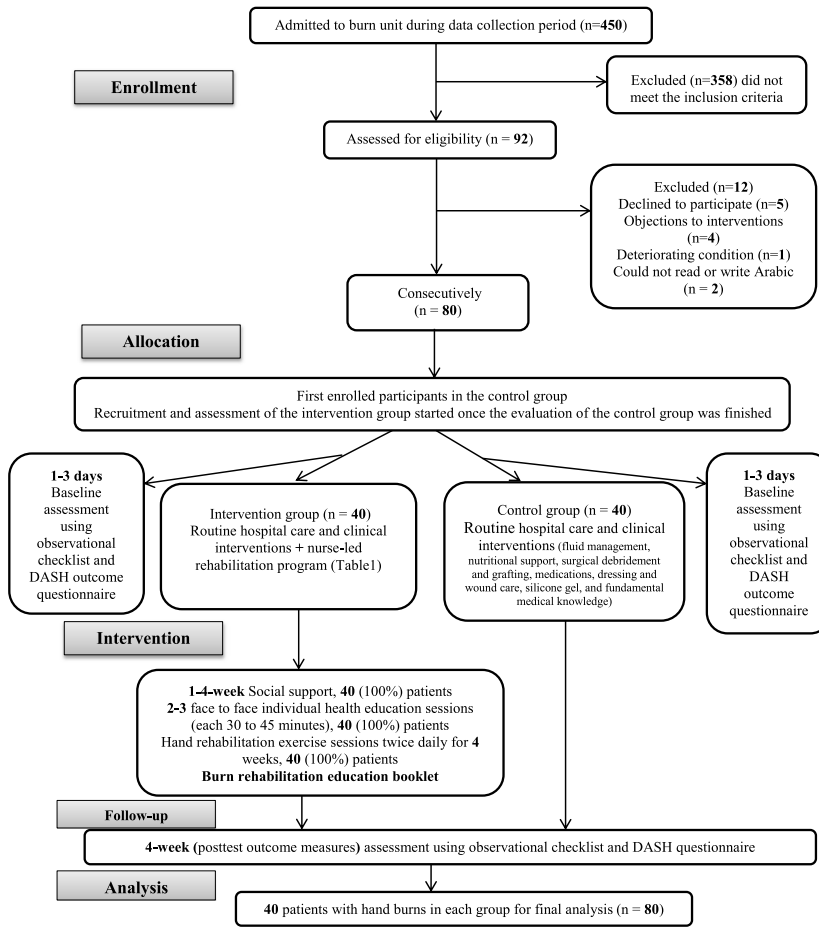

Figure 1. Flowchart of the participants' recruitment, interventions, and follow-up.

pain symptom intensity, tingling, stiffness, activity-related pain, and weakness (five items); and the impact of the problem on work, social events, self-image, and sleep (four items; Hudak et al., 1996). Participants can score interference and difficulty with ADLs on a 5-point Likert scale, with 1 indicating *no difficulty/symptom*, 2 indicating *mid difficulty/symptom*, 3 indicating *moderate difficulty/symptom*, 4 indicating *severe difficulty/symptom*, and 5 indicating *unable or very severe symptom*. Participants who scored 30–66, 67–99, and 100–150 were considered to have mild, moderate, and severe disability and severity, respectively. Participants with scores of less than 33 were considered to have no disability. The DASH has been translated into 56 languages and has proven to be a reliable and valid tool for a wide range of upper-extremity problems, including second- or third-degree hand burns (Alotaibi, 2010; Aghajanzade et al., 2019; Gummesson et al., 2003; Perera et al., 2015; Sigirtmac & Oksuz, 2021). Cronbach's alpha, the test–retest correlation coefficient, and the content validity index for the DASH were .90, .96, and .71, respectively (Beaton et al., 2001). The DASH-Arabic version (Alotaibi, 2010) was employed in this study, with a Cronbach's alpha of .96. The DASH took 10–15 minutes to administer.

Hand Motor Function Observational Checklist

Hand motor function was assessed using an observational checklist developed by the researchers after a careful review of the related studies (e.g., Ardebili et al., 2014; Lotfi et al., 2020). It was comprised of three crucial hand activities: the ability to rotate the wrist, bend the wrist, and bend the fingers. The items are scored on a 3-point Likert scale, with 3 indicating *unable*, 2 indicating *able with limitation*, and 1 indicating *able without limitation*, for a possible score of 3–9. Lower scores indicate optimal hand motor function, whereas higher scores indicate poor hand motor function. Shrotryia and Dhanda (2019) proposed that the face and content validity of HMFOC be supported through a review of the items by three burn nursing and nursing education specialists. According to the methods used by Lin et al. (1997), the interrater reliability agreement ranged from 84% to 100%, with an overall mean agreement of 92%, and the Cronbach's alpha for the HMFOC was .91 in this study.

Intervention

A registered burn nurse recruited all participants and was not involved in the outcome assessment or interventions delivery. She checked the patients' case notes every day to determine if any patient with a severe hand burn met the inclusion criteria; if so, the patient was asked to participate. The information sheet was properly explained, and the study's details and specifics were disclosed. The burn nurse then ensured that the participant had signed the consent form before passing it to a trained researcher (kept unaware of the group assignment) who completed the baseline assessment. The DASH and HMFOC questionnaires were completed (by participants or with the assistance of a trained researcher, if both hands were burned) in both the intervention and control groups twice: during the acute stage (pretest; approximately 1–3 days after admission, within 72 hours of the burn) and following completion of the intervention at 4 weeks (posttest; 1–2 days before discharge), under the supervision of a trained researcher holding a PhD in medical surgical nursing, at their private rooms in the hospital. Both groups received routine hospital care and clinical interventions at the burn unit. The intervention participants also received a nurse-led rehabilitation program (Table 1) and were informed of all measures and any participation requirements specific to their group at the beginning of each session. The interventions lasted 4 weeks and were delivered in two stages by a trained burn nurse with 5 years of experience, who had completed a mandatory burn rehabilitation training program that included theory and practice, and a senior physiotherapist, who worked at this burn unit. With a burn nurse and a physiotherapist, the time and number of health education and hand rehabilitation exercise sessions were agreed upon, considering the participants' needs and conditions.

The acute stage lasted 1–3 days after admission and included the pre-wound healing period (Seyedoshohadaee et al., 2022; Tiwari, 2012). The participants completed the sociodemographic, DASH, and HMFOC surveys under the observation of a trained researcher. A burn nurse also built the initial relationships with participants based on their mental and physical conditions (e.g., self-introduction, familiarizing herself with the participant's condition in general, evaluating the health condition) at this stage. Furthermore, participants and their family caregivers received social support during their hospital stay based on their age, educational level, and ability to learn information directly or through a family member. This was done to give directed health education so that they could become more self-confident and aware of their roles in the rehabilitation process. A burn nurse then provided the individual health education sessions (using audiovisual aids and a hand burn rehabilitation booklet) on the function and composition of normal skin, burn degrees and sizes, treatment, the wound healing process, edema reduction, hand surgeries and skin grafts, incidental symptoms of scar hyperplasia, the body functions following burns, common hand disabilities and rehabilitation exercises, and coping strategies. The burn rehabilitation booklet

included information about the program's goals, proper/correct hand position–hand splint, hand rehabilitative exercise practices (methods, frequency, and timing), ROM activities, methods to deal with positioning and to improve hand function, and strategies to improve participation in ADL. The audiovisual aids included slides, videos, and illustrated pictures that were based on the contents of the rehabilitation booklet and provided patients with clear examples. In addition, educational materials were reviewed with participants in the form of questions and answers at the end of the session. Depending on the participants' needs, which were considered, managed, and recorded in each education session, two to three individual education sessions were included for each intervention participant (each education session lasted 30–45 minutes). The program was created in response to previous burn rehabilitation research findings, and the researchers developed the burn rehabilitation booklet and audiovisual aids based on current literature and existing hand burn rehabilitation guidelines and programs (Chinese Burn Association et al., 2015; Lotfi et al., 2020; Seyedoshohadaee et al., 2022). These were then appraised by burn professionals to ensure the clarity and appropriateness of the contents.

The intervention participant's ROM was gradually increased to 10–30 minutes per exercise session, twice daily (to a limited extent, within the patient's tolerance, to prevent bleeding). A physiotherapist simultaneously performed hand rehabilitation exercises (Week 1: passive movements such as finger and palm pressures; Week 2: passive and active movements begun with projects including practicing ADLs such as feeding, dressing, and washing, as well as grasping an elastic ball and a bedrail; Week 3: passive and active movements continued; and Week 4: a grouping of functional hand rehabilitation exercises, ADL training, and active hand movements). The primary researcher closely observed the intervention group participants as they exercised in the physiotherapist's daily sessions.

The rehabilitation stage began when wound healing or graft or scar maturation began, and it continued for 4 weeks (Seyedoshohadaee et al., 2022; Tiwari, 2012). At this point, the researcher collected DASH and HMFOC questionnaires from both the intervention and control groups (1–2 days before discharge; posttest). Also, during this stage, continuous social support and active and passive hand rehabilitation exercises were provided for the intervention group participants. The questionnaire was completed by participants in their private rooms. The study survey was completed in 15–20 minutes by all participants. Fidelity was maintained by adhering to the recommendations of Bellg et al. (2004). These recommendations call for monitoring intervention delivery, standardizing interventionist training, ensuring that patients practice the exercises taught in the intervention, and ensuring that the intervention doses are similar for all intervention group participants.

Data Analysis

IBM SPSS Version 28.0 software for Windows was used to analyze the data (IBM Corp., 2021) (IBM SPSS Statistics for Windows, Version 28.0., Armonk, NY). To present the data, descriptive statistics such as percentage, frequency, mean, standard deviation, and numerical indices were first performed. The Kolmogorov–Smirnov test was employed to confirm the distribution's normality. Inferential statistics such as the chi-square test (χ^2), Mann–Whitney *U* test or Wilcoxon signed-ranks test, *t* tests, and Fisher's exact test or Monte Carlo correlation were then conducted to test the differences between control and intervention groups, depending on the data's normality and variable types. To ensure that the false discovery rate did not surpass the required level (.05), the results were subjected to the sequential Bonferroni correction method. The independent variable was a nominal level (categorical variable; nonexposure vs. exposure to a nurse-led rehabilitation program), and because DASH and HMFOC were measured as mean scores, the dependent variables were continuous. $p < .05$ (two-tailed) was used as the statistical significance criterion. All patients with severe hand burns who participated in this study were involved in the analysis. Data were kept anonymous during analysis by labeling groups with nonidentifying codes that were not dependent on whether the person participated, didn't participate, or withdrew from the study. Patients who met the inclusion criteria received an explanation of the study's objectives and methods (information sheet) by the registered burn nurse. Anonymity was employed to protect privacy by allocating identification numbers rather than personal identifiers. The interventions were also held in a quiet, private area (patients' rooms). Finally, the study's data were only accessible to the research team.

Results

Baseline Sociodemographic and Medical Characteristics of Participants

Table 2 shows the sociodemographic and medical data for both groups. The 80 participants were 46.25% men and 53.75% women. Only 10% of the intervention and control groups were 50–60 years old, and the majority were married (40% in the control group and 37.5% in the intervention group). In addition, 37.5% of the intervention group and 30% of the control group were employed, and 27.5% of the intervention group and 22.5% of the control group had completed a university degree.

Table 2 Sample Sociodemographic and Clinical Characteristics ($N = 80$)

Characteristic	Total ($n = 80$)	CG ($n = 40$) n (%)	IG ($n = 40$) n (%)	χ^2	p
Age (years)				0.131	1.000 (MC)
18 < 30	16 (20.0)	08 (20.0)	08 (20.0)		
30 < 40	18 (22.5)	10 (25.0)	08 (20.0)		
40 < 50	38 (47.5)	18 (45.0)	20 (50.0)		
50 ≥ 60	08 (10.0)	04 (10.0)	04 (10.0)		
Sex				0.050	.823 (Fisher)
Male	37 (46.25)	19 (47.5)	18 (45.0)		
Female	43 (53.75)	21(52.5)	22 (55.0)		
Marital status				0.136	.987 (MC)
Single	13 (16.25)	07 (17.5)	06 (15.0)		
Married	31 (38.75)	16 (40.0)	15 (37.5)		
Divorced	19 (23.75)	09 (22.5)	10 (25.0)		
Widowed	17 (21.25)	08(20.0)	09 (22.5)		
Education				0.993	.087 (MC)
Primary	18 (22.5)	09 (22.5)	09 (22.5)		
Intermediate	17 (21.25)	08 (20.0)	09 (22.5)		
Secondary	25 (31.25)	12 (30.0)	13 (32.5)		
University	20 (25.0)	11(27.5)	09 (22.5)		
Occupation				0.140	1.000 (MC)
Employed	27 (33.75)	12 (30.0)	15 (37.5)		
Retired	05 (6.25)	03 (7.50)	02 (5.0)		
Housewife	31 (38.75)	15 (37.5)	16 (40.0)		
Unemployed	17 (21.25)	10 (25.0)	07 (17.5)		
Residence				0.056	0.813 (Fisher)
Urban	53 (66.25)	27 (67.5)	26 (65.0)		
Rural	27 (33.75)	13 (32.5)	14 (35.0)		
Cause of burn				0.472	.790 (MC)
Fire flame	51 (63.75)	26 (65.0)	25 (62.0)		
Scalds	10 (12.50)	04 (10.0)	06 (15.0)		
Electrical	19(23.75)	10 (25.0)	09 (22.5)		
Degree of burn				0.070	1.000 (Fisher)
Deep second	34 (42.5)	16 (40.0)	18 (45.0)		
Third	46 (57.5)	24 (60.0)	22 (55.0)		
Percent of burn				0.408	.878 (MC)
20% < 25%	23 (28.75)	11 (27.5)	12 (30.0)		
25% < 50%	52 (65.0)	27 (67.5)	25 (62.0)		
50% < 75%	05 (6.25)	02 (5.0)	03 (7.50)		
Depth of burn				0.050	1.000 (Fisher)
Deep partial	37 (46.25)	19 (47.5)	18 (45.0)		
Deep full	43 (53.75)	21 (52.5)	22 (55.5)		
First aid				0.080	.870 (Fisher)
Yes	15 (18.75)	08 (20.0)	07 (17.5)		
No	65 (81.25)	32 (80.0)	33 (82.5)		
Skin graft				1.013	1.000 (Fisher)
Yes	01 (1.25)	00 (0.0)	01 (2.5)		
No	79 (98.75)	40 (100)	39 (97.5)		
Joint affected				0.082	.775 (Fisher)
Yes	65 (81.25)	2 (80.0)	33 (82.5)		
No	15 (18.75)	08 (20.0)	07 (17.5)		

Note. CG = control group; IG = intervention group; MC = Monte Carlo correlation; Fisher = Fisher's exact test.
$p < .05$.

Furthermore, 62% in the intervention group and 65% in the control group had been burned by a flame, and 55% in the intervention group and 60% in the control group had third-degree burns. Regarding burn size, 62% of the intervention group and 67.5% of the control group had burn percentages ranging from 25% to 50%. Approximately 81% of the participants did not receive first aid following the burns, and only one participant in the intervention group received a skin graft. A chi-square test (χ^2) was used to compare the sociodemographic and medical characteristics of both groups at the baseline; no significant statistical differences between the two groups were found, suggesting that the data of the two groups were homogeneous ($p > .05$; Table 2).

Nurse-Led Rehabilitation Program Effect on Functional Outcomes in the Intervention and Control Groups

Tables 3 and 4 show the mean DASH and HMFOC scores and net change of participants in the control and intervention groups pre- and post-intervention. Before the program's initiation, the two groups had comparable functional statuses and degrees of disability and symptoms ($p > .05$), but their HMFOC mean scores differed significantly ($U = 408.0$, $p < .001$). However, after 4 weeks of the intervention, statistically significant differences in DASH scores were found between the groups ($t = 5.710$, $p < .001$) and the two DASH measures: physical and symptoms ($p < .001$). The improvements in mean DASH scores between the control group ($M = 99.83$ (12.48) and $M = 112.18$ (11.07); a high level of disability and symptoms) and intervention group ($M = 109.80$ (12.56) and $M = 82.00$ (15.30); a low level of disability and symptoms) were significantly greater (–27.8) for the participants who received nurse-led rehabilitation compared to the control participants (+12.35). This indicates that the intervention improved the participants' functional outcomes. A slight improvement was also found in the HMFOC scores (better hand motor function) for the intervention participants compared to control participants ($U = 189.0$, $p < .001$). Nevertheless, no statistically significant differences were found between participants' DASH and HMFOC mean scores in terms of the groups' sociodemographic and medical characteristics after the intervention ($p > .05$). In this analysis, the interaction effect had a significant effect size (0.65; by calculation of standardized mean difference; Cohen's d), indicating a large effect of the intervention on functional outcomes, and excellent power (.82).

Discussion

To the best of our knowledge, this is the first study to examine the effect of a nurse-led rehabilitation program on

Table 3 Comparison of Variables Between Groups, Before and After Intervention ($N = 80$)

	Before Intervention				After Intervention			
	Control ($n = 40$)	Intervention ($n = 40$)			Control ($n = 40$)	Intervention ($n = 40$)		
Variable	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*/*U*	*p*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*/*U*	*p*
DASH total	99.83 (12.48)	109.80 (12.56)	0.897	.372	112.18 (11.07)	82.00 (15.30)	5.710	<.001
Physical	70.13 (11.56)	75.60 (11.41)	1.164	.248	78.40 (10.05)	56.53 (13.25)	4.891	<.001
Symptoms	23.73 (1.87)	27.33 (2.59)	0.718	.475	26.93 (2.39)	20.58 (3.22)	5.355	<.001
HMOC total	6.53 (0.82)	8.08 (0.89)	408.0	<.001	5.83 (0.96)	4.88 (1.14)	189.0	<.001
Bend wrist	2.23 (0.58)	2.80 (0.41)	424.0	<.001	1.98 (0.62)	1.40 (0.50)	388.0	<.001
Rotate wrist	2.20 (0.69)	2.68 (0.62)	508.0	.001	2.03 (0.53)	1.60 (0.50)	489.0	.001
Bend fingers	2.10 (0.50)	2.60 (0.50)	774.5	.782	1.88 (0.69)	1.83 (0.59)	436.0	<.001

Note. DASH = Disabilities of the Arm, Shoulder and Hand outcome questionnaire; HMOC = Hand Motor Function Observational Checklist; *t* = samples *t* test; *U* = Mann–Whitney *U* test.
$p < .05$.

functional outcomes in adult patients with severe hand burns admitted to a burn unit at a teaching hospital in an Arab developing country. It found that the early nurse-led rehabilitation program had a significant effect on the patients' functional outcomes. Patients who received the intervention had better functional outcomes (as measured by DASH and HMFOC) after 4 weeks than those who received only the routine hospital care and clinical interventions. Patients in this study had better functional outcomes after receiving comprehensive rehabilitation interventions from expert burn professionals, which included health education sessions with audiovisual aids and a hand burn rehabilitation education booklet, social support, family involvement, and hand rehabilitation sessions. These improvements enabled patients to perform better in self-care activities (Tang et al., 2015). The rehabilitation interventions included in this program improved physical function and reduced symptoms. Furthermore, passive and active ROM exercise, positioning, and ADL training (hand rehabilitation sessions) improved hand physical function and performance. Early continuous passive and active joint exercises, particular applications of these exercises, and pressure compression have all been shown to be effective in assisting patients to regain their hand motor functions. These techniques have progressively become common in hand burn health rehabilitation (Li et al., 2017). Three previous studies have also confirmed that early short-term hand burn rehabilitation programs are effective in reducing hand disability and symptoms, improving hand motor function and ROM, and shortening hospital stays (Li et al., 2017; Schneider et al., 2012; Tang et al., 2015). This program's content and structure may become the standard method of severe hand burns nursing rehabilitation.

However, burn rehabilitation programs are not widely used in Egypt's general hospitals, especially in the acute burn care stage (Taha et al., 2018). The model of early rehabilitation for people with burns is still relatively novel, and we are aware of only a handful of healthcare settings in Egypt that have begun burn rehabilitation programs. According to Jagnoor et al. (2018), it is unknown what burn rehabilitation services are accessible, available, or most useful for rehabilitation centers in developing nations, as

Table 4 Mean (Standard Deviation) of the Net Change Scores for DASH and HMOC Among Groups, Before and After Intervention ($N = 80$)

	Control Group ($n = 40$)		Intervention Group ($n = 40$)		Net Change			
Variable	Pretest Mean (*SD*)	Posttest Mean (*SD*)	Pretest Mean (*SD*)	Posttest Mean (*SD*)	CG ($n = 40$)	IG ($n = 40$)	*t*/*Z*	*p*
DASH total	99.83 (12.48)	112.18 (11.07)	109.80 (12.56)	82.00 (15.30)	12.35 (1.4)	−27.8 (13.9)	14.620	<.001
Physical	70.13 (11.56)	78.40 (10.05)	75.60 (11.41)	56.53 (13.25)	4.27 (1.51)	−19.07 (1.84)	14.180	<.001
Symptoms	23.73 (1.87)	26.93 (2.39)	27.33 (2.59)	20.58 (3.22)	03.20 (0.52)	−6.75 (0.63)	12.001	<.001
HMOC total	6.53 (0.82)	5.83 (0.96)	8.08 (0.89)	4.88 (1.14)	−0.70 (0.14)	−3.20 (0.25)	5.552	<.001
Bend wrist	2.23 (0.58)	1.98 (0.62)	2.80 (0.41)	1.40 (0.50)	−0.25 (0.04)	−1.40 (0.09)	5.706	<.001
Rotate wrist	2.20 (0.69)	2.03 (0.53)	2.68 (0.62)	1.60 (0.50)	−0.17 (0.16)	−1.08 (0.12)	4.962	.001
Bend fingers	2.10 (0.50)	1.83 (0.59)	2.60 (0.50)	1.88 (0.69)	−0.27 (0.09)	−0.72 (0.19)	4.716	<.001

Note. DASH = Disabilities of the Arm, Shoulder and Hand outcome questionnaire; HMOC = Hand Motor Function Observational Checklist; CG = control group; IG = intervention group; *t* = paired *t*-test results; *Z* = Wilcoxon signed-ranks test.
$p < .05$.

interventions vary and evidence on effectiveness is ambiguous. Therefore, service gaps may emerge in providing early comprehensive rehabilitation support to patients with hand burns. Meeting this need requires developing and testing such programs to ensure that patients with hand burns obtain adequate care covering their needs in a coordinated and continuous manner. This nurse-led rehabilitation program offers additional knowledge about the planning and application of professional support for patients with hand burns as well as strengthening inpatient burn care. Early rehabilitation interventions for patients with severe hand burns are critical and should begin on the day of the burn (Lotfi et al., 2020; Procter, 2010). In addition, this model of care was developed in response to a global demand for early and continuous rehabilitation care for patients with burns (Herzog et al., 2020).

Few nursing studies have assessed hand function after severe hand burns, and the majority do not report functional outcomes. Seyedoshohadaee et al. (2022) and Aghajanzadeh et al. (2019) investigated the efficacy of a rehabilitation nursing program and occupational rehabilitation in enhancing hand burn patients' daily functioning and performance. They found significant differences in pre- and post-intervention mean DASH scores, indicating that the interventions were useful in reducing the challenges experienced by patients with hand burns during daily activities. The DASH is a tool for evaluating hand function status, disability, and symptoms and has been used extensively in interventional research to evaluate functional outcomes following hand burns. Although physical function is better measured by healthcare professionals through physical examination and observation, in their systematic review, Wiitavaara and Florin (2022) stated that the DASH, a patient-reported outcome measure, represents ADLs and gross motor tasks and performance, which is a practical way to assess physical function. After the intervention in the present study, patients had lower DASH mean scores (mean = –27 points); a 10-point difference in DASH mean score reflected a minimally significant clinical change, according to Gummesson et al. (2003). However, more research is needed to determine the validity of the self-reported DASH as a functional outcome predictor in patients with burns, as well as to create or validate existing objective hand functional outcome instruments. Outcome measurement has evolved into a tool for describing, monitoring, reporting, and evaluating the effects of health interventions on patients (Wiitavaara & Florin, 2022). Nurses will be able to improve the early and long-term rehabilitation process, not just the outcomes, by measuring functional outcomes for patients with burns (Wiitavaara & Florin, 2022).

Joint contractures caused by hand burns continue to be a major source of functional disability and prevent movement (Aghajanzade et al., 2019; Edger-Lacoursière et al., 2023; Jacobson et al., 2017). According to Aghajanzade et al. (2019), hand joint contractures impact patients' physical functionality, ADLs, and QOL. Most hand contractures are ideally avoidable, and substantial effort is made to prevent or improve them during inpatient rehabilitation and acute hospitalization (Jacobson et al., 2017; Schneider et al., 2012). Many of the patients in this study had affected hand joints and some degree of joint contractures on admission because of severe burns, and they demonstrated clinically and statistically significant improvements in hand physical and motor functions after the 4-week inpatient rehabilitation. Schneider et al. (2012) reported that patients with severe hand burns who received early rehabilitation had fewer contractures (improvements in physical function and ROM) than those in a control group, indicating that understanding how to reduce the severity and morbidity of contractures in severe hand burns is critical in their rehabilitation. Therefore, our findings suggest that an early nurse-led rehabilitation program could be beneficial and feasible for patients with severe hand burns. Research is scarce on the effect of nursing rehabilitation interventions on burned-hand joint contractures, and this work may provide some evidence of their efficacy as a primary noninvasive intervention. Further research into the comparison of inpatient nurse-led rehabilitation and surgical interventions for burned-hand joint contractures is warranted.

Social support, defined as a person's connection with other social beings such as family, friends, relatives, groups, and social institutions, plays a significant role in the relationship between well-being and psychological stress (Gorbani et al., 2021; Li et al., 2017). High levels of psychological stress cause negative emotions in patients with burns, decreasing their motivation and initiative for rehabilitation training and raising the possibility of clinical symptoms, such as deformity and joint contractures (Edger-Lacoursière et al., 2023; Li et al., 2017; Waqas et al., 2016). Therefore, enhancing the family's confidence and self-awareness is crucial for the successful recovery of patients with burns (Gorbani et al., 2021). In this study, we enrolled family caregivers in the rehabilitation program team and gave them targeted health education. Understanding the prevention of complications and treatment of burns can help the patients' families regain confidence and clarify their role (providing psychological support and understanding the sources of stress and patient's needs) in the rehabilitation process (Li et al., 2017). The study's findings may have significant nursing implications for patients undergoing long-term rehabilitation for burns.

Strengths and Limitations of the Study

Some of the study's strengths should be highlighted. A detailed description of the rehabilitation program was included, as well as a variety of comprehensive interventional methods to improve functional outcomes (social support, involvement of families, health education sessions with audiovisual aids, a hand burn rehabilitation education booklet, and hand rehabilitation exercise sessions). This information could help other researchers in developing early and long-term nurse-led rehabilitation programs and interventions for patients of various ages with hand burns. Furthermore, based on current literature (systematic reviews) and updated hand burn rehabilitation guidelines and programs, we created an effective hand burn rehabilitation education booklet and program (Chinese Burn Association et al., 2015; Edger-Lacoursière et al., 2023; Lotfi et al., 2020; Seyedoshohadaee et al., 2022). This responds to previous criticism that no standard hand burn rehabilitation education booklets or programs exist for managing severe hand burns in the burn nursing literature for adults. In addition, our focus on patients with severe hand burns, who have been largely excluded from previous nursing studies on this topic, was new, allowing us to investigate the improvement in functional outcomes in this patient group. The recruitment, data collection, and program interventions were also performed by a trained team (registered nurse, expert burn nurse, and senior physiotherapist) under the supervision of the researcher to implement more objective data collection and reduce potential bias because of nonrandomization. This study also included a rigorous study design, precise data analysis measures, and a power analysis, which support the findings. The self-reported DASH and HMFOC scores of the control group participants remained constant over the course of the study, demonstrating that no contamination occurred. Social support was provided by the burn nurse during the hospital stay. This concept is important in improving health and clinical outcomes in burn patients while implementing interventions and new health practices (Waqas et al., 2016).

Using the findings from this study, there are the following limitations and suggestions for additional research. We used convenience sampling of adults, a small sample size, and a single burn setting (urban area), which may limit the findings' generalizability. However, by first recruiting and evaluating participants in the control group, this selection bias may be reduced, and the sample size was sufficient to demonstrate differences in functional outcomes with the DASH and HMFOC between the two groups. Because of lack of validated objective functional outcome measures for patients with hand burns, a subjective patient-reported measure (DASH) was used to assess hand functional outcomes. To confirm the study's findings, multicenter experimental studies with larger sample sizes, different ages, and different geographic locations using random sampling are recommended in the future. Creating or validating existing objective hand function outcome tools for patients with burns to measure hand functionality is also essential. Finally, a long-term follow-up period would be beneficial, given that continuing rehabilitation can influence hypertrophic scar formation and motor function (Jeschke et al., 2020).

Implications for Nursing Practice

Information is currently lacking to support the development of early nurse-led rehabilitation programs that are effective in enhancing functional outcomes in patients with severe hand burns. Providing such rehabilitation programs for this population in developing countries remains a concern. Our findings indicate that a nurse-led rehabilitation program can effectively improve functional outcomes in a short time, and it offers a research-based program model for nurses looking after patients with severe hand burns. Inpatient rehabilitation interventions and programs are important aspects of hand burn management because they affect functional outcomes, ADL, and QOL (Aghajanzade et al., 2019; Seyedoshohadaee et al., 2022; Tang et al., 2015). According to Seyedoshohadaee et al. (2022), implementing low-cost interventions such as nursing rehabilitation programs can greatly enhance the functioning of hospitalized burn patients, improve their QOL, and reduce readmissions. These findings may also have significant implications for patients undergoing long-term rehabilitation for hand burns, as well as those who have sustained burn injuries to other organs. Therefore, burn nurses and researchers must develop, implement, and deliver a culturally competent, comprehensive, and standard nurse-led rehabilitation program to improve the functional outcomes of persons with severely burned hands. Furthermore, they should work with other healthcare professionals (physicians, nutritionists, psychologists, and physiotherapists) to find the best common interventions that have the greatest cost–benefit ratio and a more positive effect on hand functional outcomes. This study can be used to provide useful training for nurses so that they can perform hand burn rehabilitation plans in a more fruitful and focused manner.

Conclusions

The results of this study clearly indicate the benefit of a nurse-led rehabilitation program in improving functional outcomes of patients with severe hand burns. The significant effect size found in our study indicates that the improvement in functional outcomes may be directly

Key Practice Points

- This research article describes the positive effect of a nurse-led rehabilitation program, including health education (audiovisual aids and burn rehabilitation education booklet), social support, and hand rehabilitation exercises, in improving functional outcomes in adult patients with severe hand burns.
- As the accessibility and availability of inpatient burn rehabilitation are limited in developing countries such as Egypt, this nursing model of care is extremely important for filling the service gap for patients with hand burns.
- This study can be used as a reference for clinical practice or to provide useful training for nurses so that they can perform hand burn rehabilitation plans in a more fruitful and focused manner.

attributed to the rehabilitation intervention, which depends on the involvement of a trained team (registered nurse, expert burn nurse, and senior physiotherapist). Therefore, this study provides data to support the effectiveness of such programs that addressed the rehabilitation nursing model's role in improving functional outcomes for adult patients with burns. Furthermore, it has ramifications for the future allocation of resources in Egypt's rehabilitative settings. To our knowledge, studies are lacking on the effect of nurse-led rehabilitation programs or interventions on functional outcomes in Egypt. The findings of this study could influence future research as well as the development of evidence-based practice for burned hands in inpatient nursing rehabilitation.

Conflict of Interest

The authors declare no conflict of interest.

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