Hospital rehabilitation of post-COVID-19 patients and their quality of life

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Abstract

Background: Health-related quality of life (HRQoL) is an important indicator that should be considered on par with medical indicators of health in order to better monitor a patient's overall condition. As a result of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection, many people experienced invasive treatment. Deterioration of patients' quality of life (QoL) after COVID-19 under hospital rehabilitation can negatively affect physical, psychological, and social functioning.

Aims: This article aimed to analyze changes in the QoL of patients who underwent a rehabilitation program within six months after the onset of COVID-19.

Material and methods: The study was conducted at the Independent Public Institute of Tuberculosis and Lung Diseases [Pol. Samodzielny Publiczny Zespół Gruźlicy i Chorób Płuc] in Olsztyn (Poland). The evaluation of the effects of rehabilitation among the 33 patients included the patients' QoL, which included physical, psychological, and social functioning. Thus, physical capacity, functional ability, risk of falls, mood, self-assessment in coping with activities of daily living, and risk of depression were examined. The study used the 6-Minute Walk Test (6MWT), Borg Rating of Perceived Exertion scale (RPE), Timed Up and Go test (TUG), Geriatric Depression Scale (GDS) and a set of original self-reported survey questionnaires.

Results: The study showed a statistically significant improvement in patients' performance and reduced fatigue according to the Borg RPE scale. The quality of movement improved significantly, and the risk of falls decreased. After rehabilitation, patients rated their performance higher when performing activities of daily living that required moderate physical exertion. There was a statistically significant reduction in the risk of depression. Achieving these results after the improvement period represents a successful prognosis for the return to full functional capacity of the patients.

Conclusions: Hospital rehabilitation had a positive effect on improving comfort in performing activities of daily living. The inpatient rehabilitation program significantly changed the subjective assessment of psychological well-being, as revealed by lower tendencies to depression and greater readiness to participate in social life.

Key words

physical efficiency, risk of falls, risk of depression, daily activities, quality of life.

Introduction

The definition of health-related quality of life (HRQoL) is based on the World Health Organization's (WHO) formulation of health, which assumes that health is a state of complete physical, mental, and social well-being, not merely the absence of disease [1]. Most definitions considered in medical research distinguish five basic dimensions, covering a broad spectrum of important aspects of human activity. These include physical functioning, which is mainly determined by symptoms related to the disease and the treatment administered; psychological, which refers to the emotional state of patients conditioned by various factors; social, which refers to patients' functioning in family and social roles; cognitive, which refers to receiving, processing, remembering incoming information, and a general sense of well-being [2].

HRQoL is, therefore an important indicator that should be considered on par with medical indicators of health in order to better monitor a patient's overall condition [3]. The quality of life (QoL) assessment is a valuable complement to objective information obtained through history taking, physical examination, and additional tests, as it is a subjective form of the patient's description of health [2]. At the end of 2019, the whole world encountered a type of virus that has significantly reduced people's QoL. As a result of the coronavirus, there has been an inefficiency in healthcare systems, as well as mental disorders for many people. Unprecedented methods of struggle began to be undertaken, which required the closure of vast sectors of the economy and a firm reduction in human contact, resulting in serious economic and social problems [4].

As a result of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection, some severely ill people require connection to a ventilator, as the damage to the lungs can be so extensive that a person is unable to breathe independently. However, the way the infection progresses is not so drastic in most cases. A significant number of people require emergency inpatient care to relieve bothersome symptoms rather than the immediate need to save lives. The asymptomatic course of the disease is also known. Thus, the variety of developmental phases, degree of severity, and duration of infection influence the fact that the functional state that each person will represent may develop at a completely different level, and consequently, the assessment of QoL will also be perceived differently by patients. In view of this situation, a study was conducted to see how the QoL changes for recovering patients whose health has not returned to normal after the disease, although their general condition was stable. However, they encountered difficulties in daily functioning and were therefore referred for rehabilitation.

In February 2020, the International Committee on Taxonomy of Viruses gave the newly emerged seventh coronavirus to attack humans the name SARS-CoV-2. Translating the acronym into Polish indicates that we are dealing with a virus that causes acute respiratory failure, which eventually leads to the deaths of many patients. The WHO has classified the disease resulting from SARS-CoV-2 infection as Coronavirus Disease 19 (COVID-19) [5]. While people of any age can contract COVID-19, those over the age of 60, along with comorbidities such as diabetes, chronic respiratory disease, and cardiovascular disease, among others, are more likely to develop the infection [6]. Data collected and presented by the WHO indicate that as of January 14, 2023, 661,545,258 people worldwide had been infected, and 6,700,519 had died [7].

The known pandemics so far, starting in the 20th century, are the 1918 Spanish flu (H1N1), the 1957 Asian flu (H2N2), the 1968 Hong Kong flu (H3N2) and the 2009 pandemic flu. (H1N1). They caused 50 million, 1.5 million, 1 million, and 300,000 deaths, respectively [8,9]. Thus, an optimistic trend of decreasing deaths with each successive pandemic can be observed. However, a compari-

son of these figures with the number of deaths as a result of COVID-19 indicates that the modern world, despite significant advances in the development of medicine and science, is still unable to address the most tragic consequences of the virus mutation, which is the death of millions of people. In order to successfully combat the effects of COVID-19, it is necessary to emphasize the key role of rehabilitation, which, according to the United Nations (UN), has priority in the health care system. Also, the WHO emphasizes the key role of rehabilitation in the improvement process because, under the new definition, rehabilitation is "meeting the needs of a person who is experiencing or may experience limitations in daily functioning due to aging or a medical condition" [10].

WHO has introduced, in addition to the two already existing health indicators, mortality, and morbidity, a third indicator, which is functioning. Thus, the whole process of improvement is aimed at improving a person's sphere of functioning, with the goal of gaining as much autonomy as possible, the consequence of which will be to avoid the need to generate health care expenditures. A better QoL can be ensured through rehabilitation, so it should be available to needy patients. Completely different therapeutic measures are implemented for people in the hospital compared to those that can be applied, for example, when working with recovering patients.

Aims

The original research presented in the article aimed to evaluate changes in the QoL of patients after COVID-19 under the influence of hospital rehabilitation in three possible dimensions, i.e., physical, psychological, and social functioning. The evaluation included the following characteristics: subjective level of effort expended to perform activities, motor independence, and risk of falls in relation to the performance of activities of daily living and well-being.

Material and methods

Research problems

Prior to the study, the following research problems (questions) were formulated:

1. Did the rehabilitation program have a significant impact on patients' physical functioning?
2. Did rehabilitation improve in the psychological sphere?
3. Did rehabilitation affect the return to fulfilling social roles?

Measure outcomes

The method used in the study was a diagnostic survey, the research techniques - measurement, observation, questionnaire. The tool for assessing physical functioning was the 6-minute Walk Test (6MWT). Circulatory parameters (heart rate and blood pressure) were examined before and after the test. After the test, the patient subjectively assessed the amount of effort expended to perform the activity on the Borg Rating of Perceived Exertion scale (RPE). The norm is for the patient to cover a distance of about 700 meters; if the patient walks less than 300 meters, it indicates a poor prognosis. The Timed Up and Go (TUG) test was used to assess motor independence and risk of falls. Completing the test in less than 10 seconds is the norm and is considered an indicator of full motor independence. The results obtained in the TUG test were related to the subjective evaluation of the performance of activities of daily living, which was done through data collected in the author's questionnaire survey. The Geriatric Depression Scale (GDS) designed by Yesavage et al. was used to assess the psychological and social functioning of the patients. With a score of 0-15, a normal state is evidenced by a score of 0-5; above this value, there is moderate depression (score of 6-10 points) or severe depression (score 11-15 points).

Eligibility criteria

Inclusion criteria for the study group were: (1) a history of COVID-19 within the last 6 months before the study, (2) functional deterioration compared to before the disease, (3) consent to participate in the study and (4) anonymous publication of results. Patients who suffered from COVID-19 in the period earlier than 6 months before the study were excluded from the study.

Study sample

Finally, 33 patients who were previously enrolled in the hospital rehabilitation program participated in the study. The patients who entered the study represented overall stable health; therefore, they attended breathing exercises that were combined with morning gymnastics, treadmill, and stationary bike exercises as part of their hospital rehabilitation. Patients also performed exercises using an upper limb rehabilitation rotor. They were also required to go for walks. The aforementioned activities were performed six times a week, while their intensity was in the moderate range. The tests were performed at the Independent Public Institute of Tuberculosis and Lung Diseases in Olsztyn (Poland). Measurements were taken twice - on the day of the start and end of a 3-week rehabilitation period.

Statistical analysis

The statistical analysis was performed using the T-test for dependent samples using the Statistica 10 software.

Results

Answering the first of the research questions, "Did the rehabilitation program have a significant impact on the physical functioning of the patients?" – the first to be compared was the performance index, which was the subjective evaluation of fatigue after performing the 6MWT test, in relation to the Borg RPE scale. The hospital rehabilitation program significantly affected the subjective fatigue rating during the performance of the marching test (**Table 1**). Before rehabilitation, fatigue was rated as light to moderate, while after the improvement process, it was rated as very light to moderate. A comparison of fatigue assessment results before and after rehabilitation showed statistically significant differences ($p = 0.002074$). This means that hospital rehabilitation influenced subjective perceptions of smaller differences in fatigue before and after performing the 6MWT, and thus increased exercise tolerance before the improvement process.

Table 1. Subjective assessment of fatigue on the Borg RPE scale.

Variable	Mean ± SD	p-Value
Fatigue after 6MWT before rehabilitation	2.182 ± 1.8278	0.002074
Fatigue after 6MWT after rehabilitation	1.182 ± 1.8448	

Notes: *T-test for dependent samples; marked differences are significant with p<0.05.*

Abbreviations: *PRE – Borg Rating of Perceived Exertion scale* (RPE); 6MWT – *6-minute Walk Test*; SD – *standard deviation*; *p – level of statistical significance.*

The physical functioning aspect of the patients was also analyzed in terms of motor independence and the occurrence of falls. For this purpose, the objective results obtained in the TUG test were compared with the subjective feelings of the patients, as recorded in the author's questionnaire. Prior to rehabilitation, the minimum time to perform the TUG test was 3.9 seconds, and the maximum time was 15.2 seconds. This demonstrates the varying functional status of the patients, some of whom showed independent mobility only in simple locomotor transfers. The mean of the measurements before hospital rehabilitation was 8.25 ± 2.260. The hospital rehabilitation program significantly affected the speed of distance covered when performing the TUG test (**Table 2**). After rehabilitation, the minimum time to complete the test was 3.6 seconds, and the maximum time was 12.3 seconds, while the mean of the measurements after rehabilitation was 6.87 ± 1.766. The differences proved to be statistically significant (p = 0.000001). The test was performed faster after undergoing a hospital rehabilitation program, which is a successful prognosis. This also indicates a reduction in the occurrence of the risk of falling while performing activities of daily living. The improvement in physical condition undoubtedly had an impact on the patients' functioning in daily life, as well as on their psychological state (**Table 2**).

Table 2. Comparison of TUG test results.

Variable	Mean ± SD	p-Value
TUG before rehabilitation	8.2491 ± 2.2600	0.000001
TUG after rehabilitation	6.8673 ± 1.7657	

Notes: *T-test for dependent samples; marked differences are significant with p<0.05.*

Abbreviations: *TUG – Timed Up and Go; SD – standard deviation; p, level of statistical significance.*

Patients were given a self-administered questionnaire before and after the rehabilitation period, in which they were asked to assess the level of difficulty in performing activities of daily living. Activities such as going for a 30-minute walk, doing housework, and walking upstairs were analyzed. The scores ranged between 0 and 3, with 0 indicating that the patient was unable to perform the activity and three indicating that the patient was coping without difficulty. Before the start of rehabilitation, the smallest number of points received in total among the three closed questions was 2, while the highest was 9 (**Table 3** and **Fig. 1**). This indicates that daily activities requiring effort were very difficult for some patients, while there were also some patients who had no problems at all performing the above-mentioned activities and obtained the maximum score on the subjective assessment of functioning in daily life before rehabilitation. The mean number of points obtained before the rehabilitation period was 6.24 ± 2.02. The hospital rehabilitation program increased the total number of points obtained in the closed questions. After rehabilitation, the lowest number of points received was 5, while the highest was 9. The mean number of points scored after rehabilitation was 7.82 ± 1.36. This means that patients rated their performance higher when performing activities of daily living that required moderate physical exertion. Achieving better scores after the rehabilitation period in both objective and subjective assessments represents a successful further prognosis.

Table 3. Comparison of the scores obtained in the questions of the author's survey.

Variable	Mean ± SD
Score of the author's survey before rehabilitation	6.24 ± 2.02
Score of the author's survey after rehabilitation	7.82 ± 1.36

Abbreviations: *SD – standard deviation.*

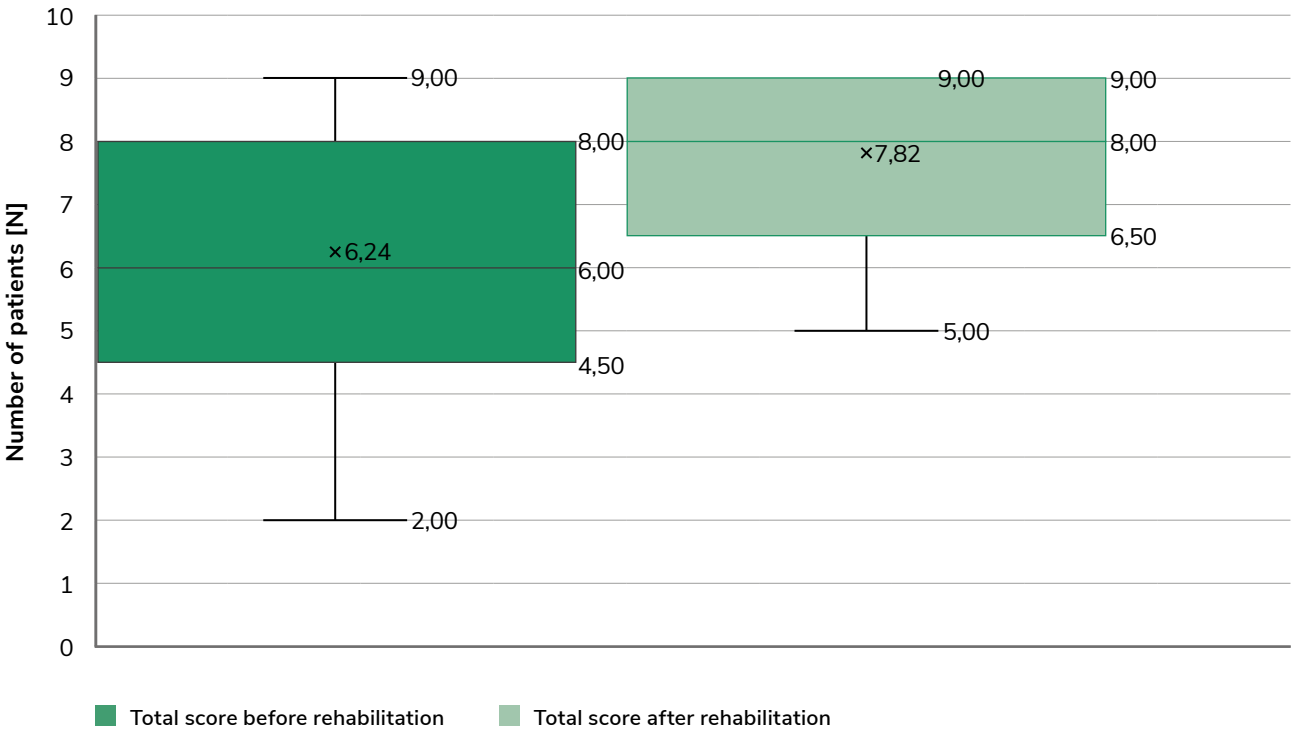

Figure 1. The total score obtained in the closed questions of the author's survey.

After the rehabilitation period, the patients were asked about their subjective assessment of the impact of the rehabilitation program on their health. All respondents said that hospital rehabilitation had significantly improved their well-being. The largest number, 52%, indicated a performance improvement. An overall improvement in health was noted by 36%. A reduction in the frequency of dizziness was also frequently observed, as well as improved fluency of movement and, consequently, dexterity. Patients repeatedly used the term "I'm breathing better" when evaluating the rehabilitation as a whole. They also indicated decreased fatigue, loss of excessive weight (**Fig. 2**). The recognition by all patients of the rehabilitation program they had undergone as beneficial and the ability to point to a characteristic that had improved is a clear response to the fact that their overall self-esteem had improved, indicating a successful future prognosis.

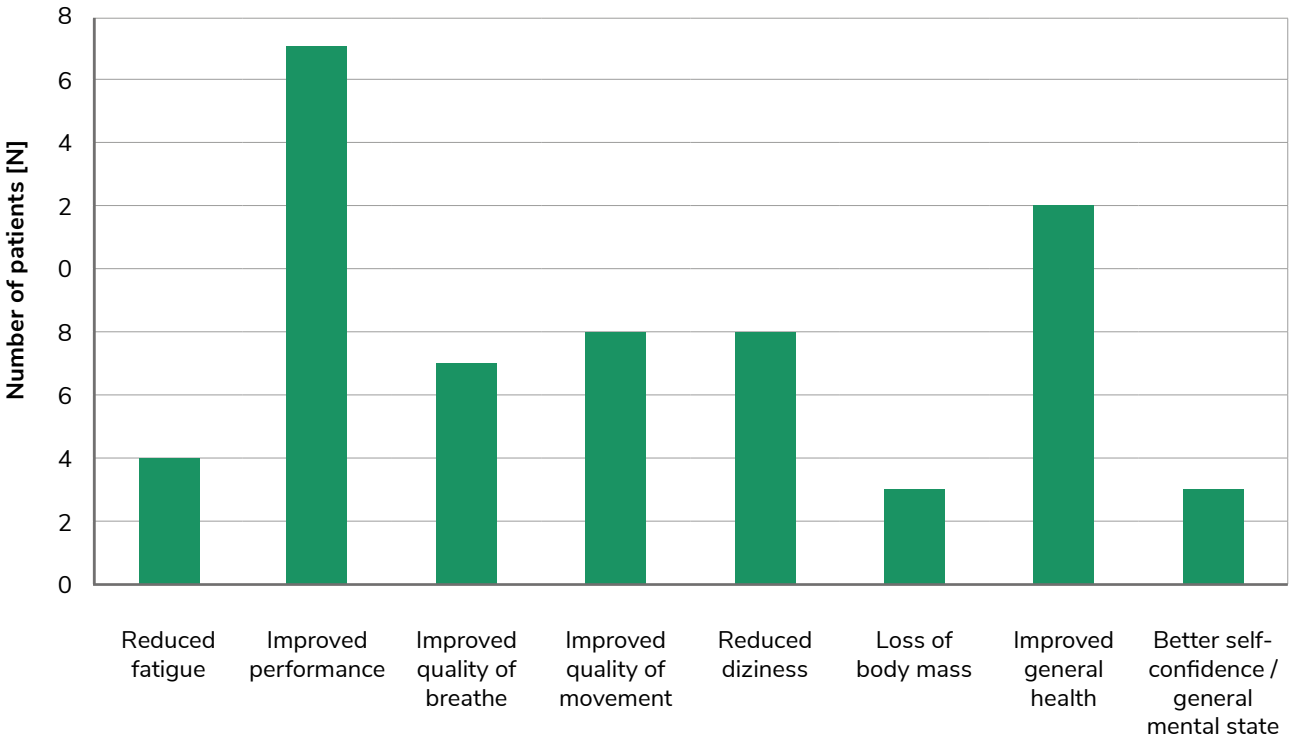

Figure 2. Summary of the most common subjective improvements after rehabilitation.

The psychological and social functioning of the patients was also analyzed. For this purpose, vulnerability to depression was assessed, and it was examined whether rehabilitation affected the return to social roles. A detailed assessment of mental status (GDS) before rehabilitation showed that the minimum number of points scored after completion was 0, and the maximum was 11 points, meaning that the condition of the study group varied greatly, from normal to severely depressed. The post-rehabilitation survey showed that the scores of all patients were in the range of 0-5 points, indicating a normal state. Statistical analysis (**Table 4** and **Fig. 3**) showed that the risk of depression decreased significantly ($p<0.05$).

Table 4. Comparison of GDS results.

Variable	Mean ± SD	p-Value
Depression tendency before rehabilitation	3.8182 ± 3.1170	0.000012
Depression tendency after rehabilitation	1.7576 ± 1.6776	

Notes: *T-test for dependent samples; marked differences are significant with* $p<0.05$.

Abbreviations: *GDS – Geriatric Depression Scale; SD – standard deviation.*

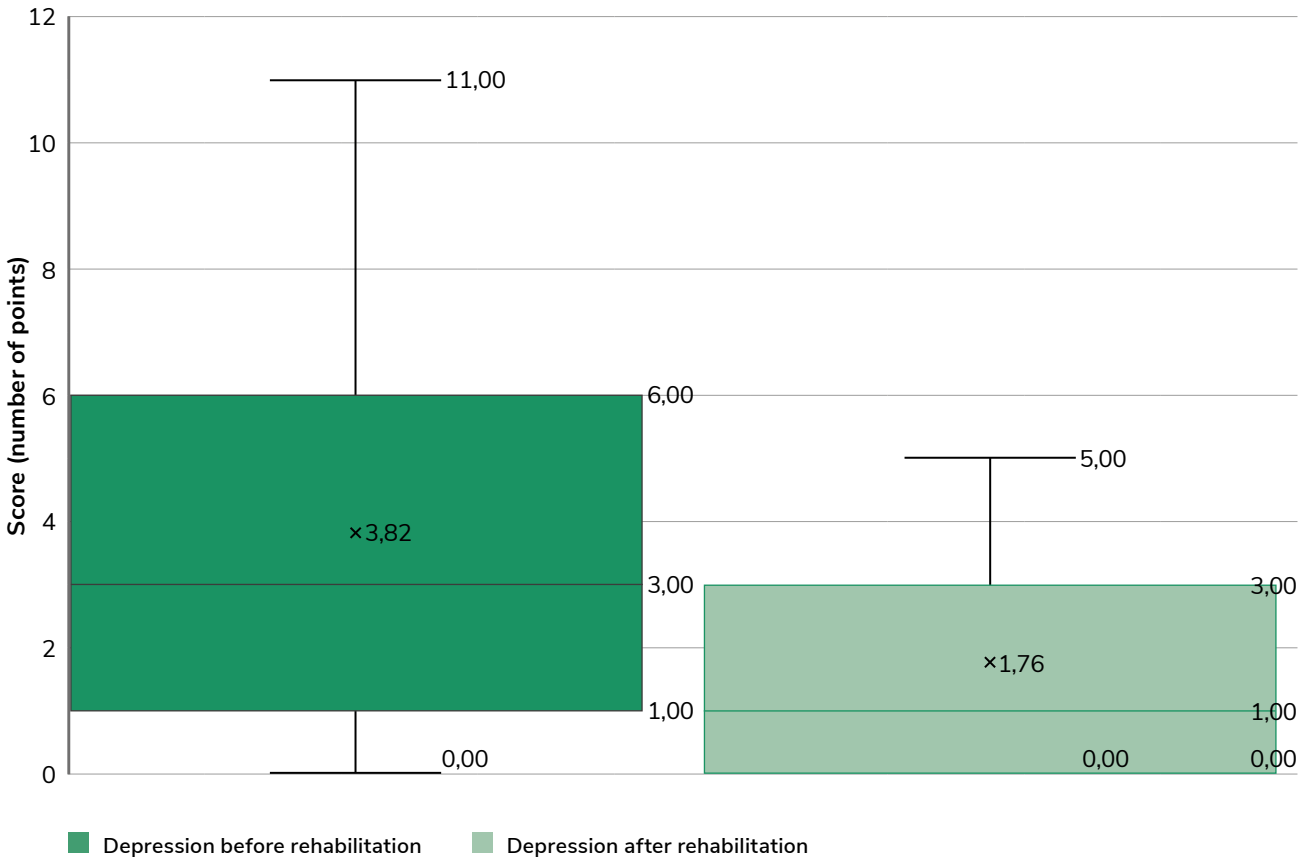

Figure 3. Subjective measurement of QoL in the mental sphere on the GDS scale.

The aspect of social functioning was assessed by answering question 9 from the GDS questionnaire: "Would you rather stay at home than go out and meet people?" Before rehabilitation, 36% of individuals responded affirmatively to this question, while after rehabilitation, only 12% of patients said they preferred to stay at home (**Fig. 4**). The results indicate that the rehabilitation program had a positive effect on the return to participation in society.

Discussion

As a result of SARS-CoV-2 infection, patients report many symptoms that affect numerous systems in the human body. It is likely that we, as a society, will continue to suffer both psychological and physical effects caused by COVID-19 for several more years to come [11]. Thus, it is of utmost importance that the most effective therapeutic interventions are selected in the improvement process. Therefore, since the observation of increased incidence, the effectiveness of selected rehabilitation interventions has begun to be studied. By analyzing our findings, we found that patients' QoL improved after rehabilitation. The article shows mainly the aspect of subjective assessment of patients' well-being. It is worth emphasizing that, in addition to the quantitative results obtained, the individual assessment of the patients' ability to function in everyday life and to recover is extremely important. Based on our study, it was found that physical functioning improved in the subjective assessment as a result of the 3-week rehabilitation period.

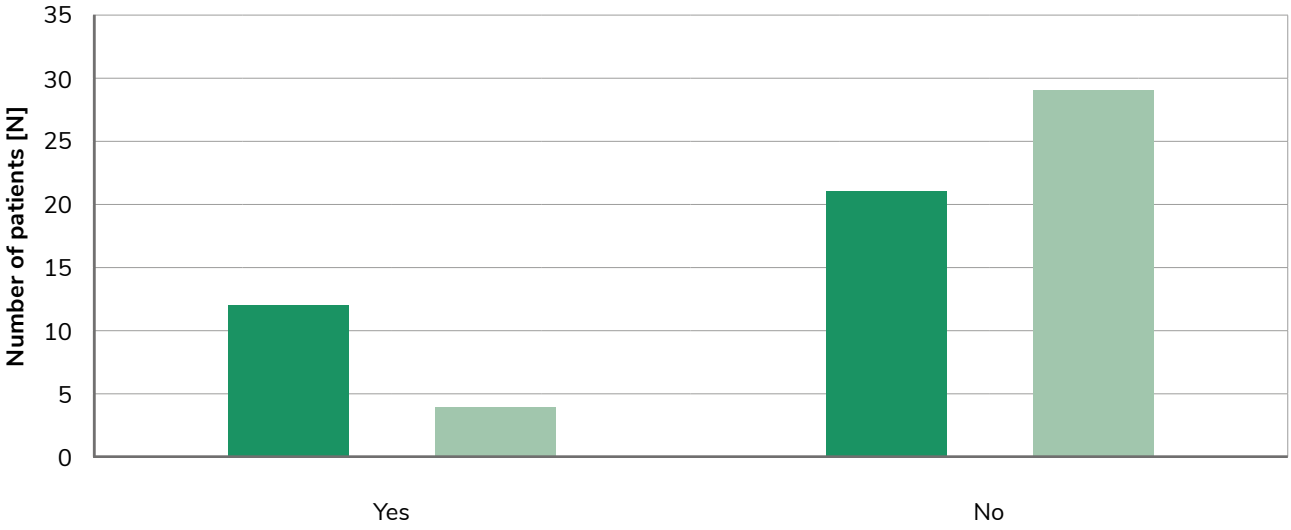

Figure 4. Comparison of the frequency of affirmative responses to question 9 on the GDS scale.

Such results were also seen in the work by Paneroni et al. [12]. The study investigated the effectiveness of the impact of early telerehabilitation after hospitalization for COVID-19-associated pneumonia. During admission and discharge, patients who represented an overall stable condition but had exercise-induced desaturation were checked for, among other things, fitness based on the distance covered in the 6MWT and dyspnea assessment according to the Barthel index [13]. Patients were given appropriate recommendations for a set of exercises and were provided with consultation with a physiotherapist twice a week. Besides the physiotherapist's check-up, patients were telemonitored daily by nurses for the first two weeks to check for any clinical needs. After one month, the distance covered in the 6MWT increased in 75% of patients. The sensation of dyspnea decreased by as much as 83.3%. This indicates that it is possible to conduct effective rehabilitation remotely and thus perhaps provide assistance to a large number of recovering patients more efficiently without long waits for outpatient rehabilitation. Finally, it indicates that objective and subjective assessment capacity has improved.

A study by Liu et al. [14] analyzed the effect of breathing exercises on the ability to perform activities of daily living more fluently. They found no significant improvement either within the intervention group or compared to the control group. Therefore, it can be concluded that the improvement in the quality of daily functioning must be supported by a stronger, more functional rehabilitation intervention. The achievement of a statistically significant improvement in indicators of coping with activities of daily living for the patients included in our study is probably related to the fact that they had to participate in various types of exercise actively, had a defined daily rhythm, and were obliged to perform programmed activities every day, which translated into the overall development of smoother movements. This was also evidenced by a statistically significant improvement in the TUG test and subjectively better functioning as perceived by the patients. At this point, it is also worth noting that it is not only direct contact with COVID-19 that causes some people to experience impaired movement quality.

In their study, Cereda et al. [15] highlight the problem of lack of physical activity and the increasingly common sedentary lifestyle in healthy older adults, whose way of functioning has been altered by the indirect effects of the virus. Fear of contracting the disease and awareness of being part of a group with an increased risk of contracting COVID-19 proved to be a key factor in many cases in limiting contact with the outside world. The studies cited above identified this isolation as a predisposing factor in the increased incidence of fall risk. In their study, the authors indicate that a specially selected set of Kunte exercises, based on sequences of oriental-type movements, arranged in accordance with the theoretical and practical foundations of physiotherapy and the methodological and pedagogical principles of physical education, after three months of performance results in significantly better results in the assessment of dynamic body balance and gait. Referring critically to the results of our own study, it should be emphasized that in future studies, it would be worthwhile to compare the results obtained in the author's questionnaire in recovering patients after hospital rehabilitation with those obtained, for example, among healthy older adults who have significantly reduced movement outside the home in their daily lives. The problem of not taking up physical activity is common not only among older adults but, unfortunately among the entire population. In the case of those included in our study, only 3% of the total met the recommendations for taking up physical activity made by the WHO.

Meanwhile, Sallis et al. [16] have shown that regular physical activity may be a key action that can be taken to prevent a severe course of COVID-19 and severe complications, including even death. The mental condition of patients is important in their recovery. The fact that 58% of the patients we studied were hospitalized during the infection indicates that they may have developed some kind of mental health disorder. Being hospitalized had an adverse effect on mental health, which was confirmed by the results of the depression scale survey. Some patients were severely depressed before rehabilitation. In contrast, participation in the hospital rehabilitation program had a statistically significant effect on reducing the risk of depression, with all subjects leaving the ward in a normal state. This was probably due to the patients' sense of overall health stability and their attitude that hospitalization during rehabilitation is intended to improve later quality of life. In addition, patients were required to participate in group activities, which positively affected the subjects' social sphere. During the course of the turnout, they stayed in the same ward, in multi-bed rooms.

Dissimilar results were obtained in the work of Liu et al. [14]. They proved that six weeks of pulmonary rehabilitation could affect less anxiety in elderly patients with COVID-19 but had a slight improvement when treating depression. This may be because the study group was much bigger and had no closer relationships with each other. The International Task Force suggests that psychological evaluation of patients should be implemented as early as 6-8 weeks after hospital discharge [17]. They justify this on the grounds that typical symptoms reported one year after leaving the Intensive Care Unit (ICU), including symptoms reported by patients with acute respiratory distress syndrome, including anxiety (34%), depression (33%), and post-traumatic stress disorder (19%) [18].

In the case of post-COVID-19 patients, especially those who are hospitalized, this is compounded by emotional stress, which is probably due to isolation from the closest environment. In fact, if I had studied patients who are not in good general condition and are therefore hospitalized, the obtained results would probably have been less optimistic than those presented in this paper. A study by Kong et al. [19] found that of the 144 patients studied who were hospitalized and were concurrently infected with the SARS-CoV-2 virus, 34.7% and 28.5% of patients, respectively,

had symptoms of anxiety or depression. Bivariate correlations showed that lower social support was correlated with higher anxiety. This demonstrates the need to implement mental health diagnostics. Highlighting the problem and appropriate intervention are essential for clinical care for those at risk of developing mental health disorders. An element that supports the ability to cope with isolation and loneliness can be the use of virtual reality in the rehabilitation process.

A study conducted in New York by Kolbe et al. [20] was designed to investigate whether patients and medical staff would receive potential health benefits after participating in virtual reality sessions involving three categories of experiences: guided meditation, exploration of natural environments, and cognitive stimulation games. The implemented program was rated as highly satisfactory, with perceived benefits by participants. Therefore, using virtual reality is useful in coping with isolation and loneliness and can be implemented in the context of clinical care for COVID-19 patients as part of a comprehensive rehabilitation model. However, a major disadvantage of using the above method is the high cost of purchasing the necessary equipment, which is certainly the reason for the lack of implementation of modern technology into daily rehabilitation practice in most hospitals.

In summary, the selection of therapeutic interventions in the group included in our study proved to be effective. However, there are studies in the available literature that show a variety of other approaches that are equally effective. Chuang et al. [21] put particular emphasis on a well-structured and multidisciplinary approach to patient rehabilitation. In addition to physiotherapy, all patients received occupational therapy. Those who had persistent speech disorders could benefit from speech therapy. Balance training was introduced as a separate form of therapy. In the case of inpatient rehabilitation in Olsztyn, patients had access to medical care, nursing care, and supervision by physiotherapists. At the same time, there was no occupational therapy or cooperation with a speech therapist, psychologist, or dietician. Expanding the team to include occupational therapists would be beneficial in that they would be involved in improving the performance of activities of daily living and educating patients. In addition, the study by Chuang et al. [21] enriched the clinical care module by recommending low-intensity and repeated exercise according to instructional videos and photos. The hospital-based rehabilitation group I underwent did not use such approaches.

Conclusions

Subjective fatigue assessment on the Borg scale was statistically significantly reduced during testing, indicating a subjective increase in exercise tolerance before the rehabilitation period. This may be a motivating element for patients to undertake not only further rehabilitation but, above all, daily physical activity. After rehabilitation, the number of patients encountering subjective difficulties in daily functioning decreased, indicating improved comfort in performing daily activities. This represents a successful prognosis for further recovery and significantly improves the overall independence of each patient. After hospital rehabilitation, all patients made a higher subjective overall self-assessment compared to the period before rehabilitation. The noted improvement represents a successful prognosis and indicates the effectiveness of the measures taken during the turnout. The inpatient rehabilitation program significantly changed the subjective assessment of psychological well-being - patients were less likely to be depressed and more willing to participate in social life. In assessing the effects of rehabilitation, in addition to physical functionality, the psychological aspect should also be taken into account, as only the combination of both elements indicates the functional status of the patient.

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