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Original research article

The impact of comorbidity burden and age on the health-related quality-of-life of individuals one year after COVID-19 pneumonia

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Abstract

Introduction: Assessing the long-term impact of the 2019 coronavirus (COVID-19) on individuals' physical and psychological well-being is crucial, and it is often measured through health-related quality of life (HRQOL).

Objective: The research aimed to examine subjective health assessment using the Short Form 36 Health Survey (SF-36) tool in subjects one year after COVID-19 pneumonia, and to identify the impact of comorbidity burden (assessed quantitatively by applying the Charlson Comorbidity Index [CCI]), and age on the indicators of physical and psychological health domains.

Methods: The research was conducted using a telephone survey to evaluate the HRQOL of 170 individuals one year after COVID-19 pneumonia and 20 individuals of the comparison group (CG).

Results: The results show significantly lower physical and mental component summary indicators in individuals one year after COVID-19 pneumonia of the Risk Class III and IV severity compared to those who had COVID-19 pneumonia of the Risk Class II severity and CG At the same time, age showed a negative effect on both physical and psychological health indicators. In addition, the general health status of individuals one year after COVID-19 pneumonia in relation to Risk Classes III and IV, as well as Risk Class II with CCI of ≥3 points, was significantly lower vs those who had CCI of 0–2 points.

Conclusion: The presence and number of comorbidities and older age are significantly associated with lower HRQOL in individuals one year after COVID-19 pneumonia. Therefore, the prospective monitoring of individuals exposed to SARS-CoV-2 and recognizing the potential factors associated with poor HRQOL is crucial to understanding the long-term impact of COVID-19 and developing personalized strategies for the clinical management of those subjects with the aim of improving their quality of life.

Keywords: Comorbidity; COVID-19; Health-related quality of life; Outcomes; Pneumonia

Abbreviations:
BP, Bodily Pain; RE, Emotional Role Functioning; GH, General Health; MH, Mental Health; PF, Physical Functioning; RP, Physical Role Functioning; SF, Social Role Functioning; VT, Vitality.

Introduction

Since January 2020, there have been approximately 689,912,493 documented cases of coronavirus 2019 (COVID-19) globally, leading to 6,887,333 fatalities (Worldometer, 2022). Enhanced detection methods for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), improved clinical treatments, advancements in drug development, widespread vaccination efforts, and the emergence of the less severe Omicron variant, have resulted in many countries now relaxing COVID-19 restrictions. They are also transitioning from treating COVID-19 as an emerging infectious disease to treating it as a common respiratory infection similar to seasonal influenza. Nonetheless, when compared to influenza, the Omicron variant of COVID-19 exhibits a higher fatality ratio, increased transmissibility, and the potential for unpredictable future outbreaks due to the uncertainty of viral mutations (Karako et al., 2022).

Preliminary data suggests that within the European Union, approximately 80% of COVID-19 cases are associated with mild illness, while 14% require hospitalization, and 6% necessitate admission to an intensive care unit (ICU) (Kinross et al., 2020). A prospective observational cohort study ISARIC WHO CCP-UK shows that one out of 5 adults suffer from conditions that are severe enough to require hospitalization (Docherty et

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al., 2020). Gude-Sampedro et al. (2021) point out that 15–20% of COVID-19 patients progress to severe pneumonia, which will cause death in 1–5% of patients.

Even more striking figures are reported in a study of 243 patients with COVID-19 pneumonia, which shows an in-hospital mortality rate of 6.6%, while 33.3% developed severe disease, 9.5% critical disease, and 9.1% were admitted to the intensive care unit (Melendi et al., 2020). Notably, the presence of multiple comorbidities is linked to worse outcomes and higher mortality rates, primarily due to the heightened severity of lung injury (Guan et al., 2020; Kamyshnyi et al., 2020; Krynytska et al., 2021). Advanced age has also been identified as an independent predictor of mortality in COVID-19 patients (Zhou et al., 2020).

However, even with the high COVID-19 mortality rate, most patients recover from acute infection. Thus, there is a pressing need for long-term follow-up studies to evaluate the after-effects experienced by individuals who have survived COVID-19 (Zhou et al., 2021). In recent publications, a range of enduring physical, cognitive, and psychological symptoms, referred to as "Long COVID", have been documented in individuals who have recovered from COVID-19. These symptoms, which persist even after discharge from the hospital, include persistent fatigue, breathing difficulties, challenges with concentration and memory, muscle and joint pain, as well as manifestations of anxiety, depression, and post-traumatic stress disorder (Brehon et al., 2022; Domingo et al., 2021; Saverino et al., 2021). The World Health Organization (WHO) defines Long COVID as post-acute COVID-19 sequelae which last at least 3 months' post infection and are not explained by any other diagnosis (Soriano et al., 2022). These long-term effects are relatively common; the WHO estimates that 10–20% of the population develops them after suffering COVID-19 (Kaidar et al., 2022).

Assessing the long-term impact of a disease on individuals' physical and psychological well-being is crucial, and this is often measured through health-related quality of life (HRQOL). The utilization of HRQOL can assist in assessing multiple aspects related to a disease, including disease severity, treatment effectiveness, patient satisfaction with care, quality of services, overall well-being of patients, and the cost-effectiveness of interventions aimed at addressing the disease (Kaso et al., 2021). HRQOL is often evaluated with questionnaires, both disease-specific and generic, addressing different domains of human functioning. One of the most widely used generic HRQOL questionnaires is the Short Form 36 Health Survey (SF-36) (Lins and Carvalho, 2016; Megari, 2013). However, as COVID-19 is a new disease, little is known about its impact on HRQOL.

Materials and methods

Study design and research sample

This study aimed to examine subjective health assessment using the SF-36 tool in subjects one year after COVID-19 pneumonia, and to identify the impact of comorbidity burden (assessed quantitatively by applying the Charlson Comorbidity Index [CCI]), and age on the indicators of physical and psychological health domains.

The first stage of this study was a retrospective non-interventional, single case-cohort study, which was conducted using the medical records of 208 patients who were consecutively admitted for treatment of community-acquired pneumonia to the pulmonology department of Ternopil regional clinical hospital (Ternopil, Ukraine) from mid-January to the end of April 2021. At the time of admission, the patients had a negative swab test for the SARS-CoV-2 virus.

The study inclusion criteria were as follows: positive swab test for the SARS-CoV-2 virus no later than one month before being admitted for the in-patient treatment; presence of the symptoms of acute respiratory infection; and evidence of community-acquired pneumonia on a high-resolution computed tomography scan.

The exclusion criteria included patients under the age of 18, and patients who were pregnant or breastfeeding a baby.

Based on data derived from medical records, patients were placed into three groups according to the Pneumonia Patient Outcomes Research Team (PORT) score: patients with pneumonia of a Risk Class II (n = 124, group II), Risk Class III (n = 68, group III), and Risk Class IV (n = 16, group IV) according to the Ukrainian adapted evidence-based clinical guideline "Nosocomial pneumonia in adults: etiology, pathogenesis, classification, diagnosis, antimicrobial therapy and prevention" (Feshchenko et al., 2019) based on NICE Guideline 191: Pneumonia: Diagnosis and management of community- and hospital acquired pneumonia in adults (NICE, 2022).

A comparison group (CG, group I) comprised patients (n = 27) admitted to the pulmonology department of Ternopil regional clinical hospital during the same period who had a positive swab test for the SARS-CoV-2 virus no later than one month before being admitted for in-patient treatment, symptoms of acute respiratory infection, and absence of pneumonia in the high-resolution computed tomography scan.

The Charlson Comorbidity Index (CCI) was calculated using a custom computer program. CCI ≥3.0 was considered diagnostically significant (Haupt et al., 2012; Quan et al., 2011).

The results of the first stage of this study showed a significant impact of comorbidity burden on the severity of COVID-19 pneumonia. In particular, a low CCI score of 0 to 2 was found in the majority of the patients in the pneumonia Risk Class II and Risk Class III groups, and a high CCI score of ≥3 in the majority of the patients in the pneumonia Risk Class IV group. Moreover, direct correlation between the CCI and the age of inpatients with COVID-19 pneumonia was established.

The second stage of the study involved a cross-sectional telephone survey to evaluate HRQOL of the first stage of our study participants (170 individuals with COVID-19 pneumonia and 20 individuals in the CG) one year after discharge. The second stage of the study excluded the eight patients who had died prior to the survey (3.85% mortality rate; 3 females and 5 males; 3 individuals with Risk Class II and 5 individuals with Risk Class III pneumonia; 3 individuals of 75–80 years of age, with CCI = 4, 1 85-year old patient with CCI = 1, and 4 middle-age patients with CCI = 5–8); 12 patients who could not be interviewed because of re-hospitalization due to stroke, myocardial infarction or pulmonary embolism and other complications; and 18 patients who refused to participate in the study. Seven individuals in the CG refused to participate in the study. In total, 106 patients with Risk Class II pneumonia, 52 patients with Risk Class III pneumonia, 12 patients with Risk Class IV pneumonia, and 20 CG patients were included in the second stage of the study.

One of the authors conducted the cross-sectional telephone survey with the COVID-19 pneumonia survivors following their discharge from hospital. The researcher administering the survey was unknown to the patients and had nothing to do with the delivery of their care. This reduced potential social desirability bias, *i.e.*, patients reporting a more positive outcome to please the treating staff.

Characteristics of the questionnaire

HRQOL was determined using the Questionnaire Medical Outcomes Study Short Form 36 (MOS SF-36), which was translated from English to Ukrainian. The translation was completed with the assistance of the International Quality of Life Assessment centre (Boston, USA) (Feshchenko et al., 2002). The welfare level was identified by 8 scales: Physical Functioning (PF), Physical Role Functioning (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social Role Functioning (SF), Emotional Role Functioning (RE), and Mental Health (MH). The eight sub-domain scores were aggregated into two summary indicators: physical component summary (PCS) scores and mental component summary (MCS) scores, where a low MCS or PCS (<50) is indicative of a poor HRQOL. The mean z-scores for the items in each scale were calculated.

Data analysis

Statistical analysis of data was carried out using the STATISTICA 7.0 software. Absolute indicators are presented in the form of the average value (Mean) and its standard deviation (SD). Comparative analysis of absolute indicators was carried out using the parametric ANOVA test. Relative values, which were presented in the form of a percentage ratio, were compared using the Pearson test. The differences were considered statistically significant at $p < 0.05$. Correlations were determined using the Pearson coefficient. The SF-36 questionnaire results were analysed using a generally accepted methodology. Cronbach's alpha coefficient was used to measure the internal consistency of the questionnaire scales. We used the traditional cut-off value of 0.81 and higher as acceptable.

Results

Analysis of the SF-36 questionnaire responses showed a significantly lower PCS rate in individuals one year after COVID-19 pneumonia of Risk Classes III and IV compared to those who had pneumonia of Risk Class II and the CG (Table 1). The PF according to SF-36 was the lowest in the Risk Class IV group and significantly differed compared to the Risk Class II group and CG. The quality-of-life component, RP, had the lowest value in individuals one year after COVID-19 pneumonia of Risk Classes III and IV groups compared to those who had pneumonia of Risk Class II group and the CG. The BP indicator shows a similar trend, while at the same time it was also significantly lower in those individuals in the Risk Class II group compared to the CG. Similarly, analysis of the GH indicator shows significantly lower values in individuals one year after COVID-19 pneumonia of Risk Classes III and IV groups compared to this indicator in individuals of Risk Class II group and the CG.

Table 1. Evaluation of the physical health domain in individuals one year after COVID-19 pneumonia, based on the SF-36 questionnaire results

Quality-of-life indicator		Risk Class II group	Risk Class III group	Risk Class IV group	CG	$p < 0.05$*
Physical health (physical component summary)	Overall score	42.36 ± 9.00	38.33 ± 9.16	35.00 ± 6.54	48.85 ± 7.46	$p_{II–III, II–IV}$ $p_{II–CG, III–CG}$ $p_{IV–GC}$
Physical functioning	Overall score	62.58 ± 26.07	53.71 ± 29.21	40.00 ± 21.29	84.07 ± 19.47	$p_{II–IV, II–CG}$
	PF–Z	–0.96 ± 1.14	–1.35 ± 1.28	–1.94 ± 0.93	–0.02 ± 0.85	$p_{III–CG}$ $p_{IV–CG}$
Role-physical functioning	Overall score	63.52 ± 41.93	43.18 ± 40.56	28.13 ± 27.20	78.70 ± 33.76	$p_{II–III, II–IV}$
	RP–Z	–0.52 ± 1.24	–1.12 ± 1.20	–1.57 ± 0.80	–0.07 ± 1.00	$p_{III–CG}$ $p_{IV–CG}$
Bodily pain	Overall score	62.66 ± 20.19	51.39 ± 18.48	45.12 ± 18.03	74.15 ± 21.94	$p_{II–III, II–IV}$ $p_{II–CG}$
	BP–Z	–0.54 ± 0.86	–1.02 ± 0.78	–1.29 ± 0.77	–0.06 ± 0.93	$p_{III–CG}$ $p_{IV–CG}$
General health	Overall score	51.68 ± 9.86	42.38 ± 13.86	40,69 ± 9,64	55.89 ± 6.97	$p_{II–III, II–IV}$
	GH–Z	–0.99 ± 0.35	–1.38 ± 0.36	–1.56 ± 0.48	–0.81 ± 0.35	$p_{III–CG}$ $p_{IV–CG}$

Note: p – independence test; * statistically significant; CG – comparison group.

Comparison of the quality-of-life indicators to the CCI, showed that the PCS indicator was significantly lower in individuals with a low CCI who suffered pneumonia of the Risk Classes III and IV groups compared to individuals who suffered pneumonia of Risk Class II group and CG. At the same time, it is notable that the PCS indicator was significantly lower in individuals in the Risk Class II group with a high CCI, compared to those with a low CCI (Table 2).

The PF indicator had significantly lower values in all observation groups with a low CCI. At the same time in individuals with a high CCI it was significantly low only in the Risk Class IV group, compared to the CG; in individuals of the Risk Class II group with a high CCI, the PF indicator was significantly lower compared to the same indicator with a low CCI. The RP indicator in previously hospitalized patients with pneumonia of Risk Classes III and IV, and either low or high CCI, was significantly lower compared to the Risk Class II group and the CG. The BP indicator in individuals with a low CCI who suffered pneumonia of Risk Classes III and IV groups was significantly lower compared to individuals who suffered pneumonia of

Table 2. Evaluation of the physical health domain in individuals one year after COVID-19 pneumonia, based on SF-36 questionnaire results and CCI score

Quality-of-life indicator		Risk Class II group	Risk Class III group	Risk Class IV group	CG	$p < 0.05$*
Physical health	CCI 0–2 points	43.41 ± 8.91	39.22 ± 9.68	38.57 ± 7.00	49.62 ± 7.34	$p_{II–III, II–IV}$ $p_{III–CG, IV–CG}$
	CCI ≥3 points	38.64* ± 8.55	36.07 ± 7.53	33.80 ± 6.23	42.73 ± 6.36	–
Physical functioning	CCI 0–2 points	65.87 ± 25.00	57.38 ± 29.80	53.75 ± 21.75	85.42 ± 19.16	$p_{II–CG, III–CG}$ $p_{IV–CG}$
	CCI ≥3 points	51.00* ± 27.58	45.22 ± 26.22	35.42 ± 19.94	73.33 ± 22.55	$p_{IV–CG}$
Role-physical functioning	CCI 0–2 points	64.80 ± 42.75	45.25 ± 43.56	31.25 ± 37.50	81.25 ± 31.49	$p_{II–III, II–IV}$ $p_{III–CG, IV–CG}$
	CCI ≥3 points	60.00 ± 38.86	36.96 ± 33.60	27.08 ± 24.91	58.33 ± 52.04	$p_{II–III, II–IV}$ $p_{III–IV}$
Bodily pain	CCI 0–2 points	65.09 ± 20.48	54.64 ± 18.38	43.75 ± 9.84	77.38 ± 21.05	$p_{II–III, II–IV}$ $p_{II–CG, III–CG}$ $p_{IV–CG}$
	CCI ≥3 points	52.28* ± 15.57	45.87 ± 17.98	45.58 ± 20.39	48.33 ± 6.35	–
General health	CCI 0–2 points	52.80 ± 7.09	45.21 ± 7.07	46.75 ± 9.03	56.33 ± 6.88	$p_{II–III, II–CG}$ $p_{III–CG, IV–CG}$
	CCI ≥3 points	47.04* ± 16.04	37.72* ± 20.34	38.67* ± 7.31	52.33 ± 8.08	$p_{III–CG, IV–CG}$

Note: p – independence test; * statistically significant; CG – comparison group; CCI – Charlson Comorbidity Index.

Table 3. Assessment of the psychological health domain in individuals one year after COVID-19 pneumonia, based on the SF-36 questionnaire results

Quality-of-life indicator		Risk Class II group	Risk Class III group	Risk Class IV group	CG	$p < 0.05$*
Mental health (mental component summary)	Overall score	45.54 ± 5.94	40.77 ± 7.86	35.07 ± 6.30	46.76 ± 5.59	$p_{II–III, II–IV}$ $p_{III–CG, IV–CG}$
Vitality	Overall score	55.78 ± 10.46	49.39 ± 13.63	41.87 ± 13.15	65.56 ± 12.43	$p_{II–III, II–IV}$ $p_{II–CG, III–CG}$ $p_{IV–CG}$
	VT–Z	–0.25 ± 0.50	–0.56 ± 0.65	–0.92 ± 0.63	0.22 ± 0.60	
Social functioning	Overall score	66.77 ± 18.65	55.70 ± 25.13	39.06 ± 17.00	73.61 ± 16.75	$p_{II–III, II–IV}$ $p_{III–CG, III–IV}$ $p_{IV–CG}$
	SF–Z	–0.72 ± 0.75	–1.14 ± 0.94	–1.99 ± 0.76	–0.45 ± 0.75	
Role-emotional	Overall score	70.22 ± 34.50	51.01 ± 37.08	18.75 ± 20.97	80.25 ± 28.13	$p_{II–III, II–IV}$ $p_{III–CG, III–IV}$ $p_{IV–CG}$
	RE–Z	–0.34 ± 1.04	–0.92 ± 1.12	–1.89 ± 0.63	–0.03 ± 0.85	
Mental health	Overall score	59.32 ± 12.28	48.41 ± 15.11	48.50 ± 11.67	64.74 ± 11.42	$p_{II–III, II–IV}$ $p_{III–CG, IV–CG}$
	MZ–Z	–0.83 ± 0.55	–1.35 ± 0.52	–1.46 ± 0.65	–0.56 ± 0.63	

Note: p – independence test; * statistically significant; CG – comparison group.

Table 4. Evaluation of the psychological health domain in individuals one year after COVID-19 pneumonia, based the SF-36 questionnaire results and CCI score

Quality-of-life indicator		Risk Class II group	Risk Class III group	Risk Class IV group	CG	$p < 0.05$*
Mental health (mental component summary)	CCI 0–2 points	45.33 ± 6.24	41.95 ± 8.14	33.89 ± 3.66	47.22 ± 4.96	$P_{II–III, II–IV}$ $P_{III–IV, III–CG}$, $P_{IV–II}$
	CCI ≥3 points	45.69 ±5.63	39.14 ±6.86	35.46 ±7.06	43.15 ± 10.04	$P_{II–III, II–IV}$ $P_{IV–CG}$
Vitality	CCI 0–2 points	56.07 ± 10.41	51.67 ± 13.24	47.50 ± 17.08	66.87 ± 11.40	$P_{II–III, II–CG}$ $P_{III–CG, IV–CG}$
	CCI ≥3 points	54.80 ± 10.65	44.78* ± 13.61	40.00 ± 11.87	55.00 ± 18.03	$P_{II–III, II–IV, IV–CG}$
Social functioning	CCI 0–2 points	68.11 ± 15.86	60.12 ± 21.25	37.50 ± 10.21	74.48 ± 16.68	$P_{II–III, II–IV}$ $P_{III–IV, III–CG}$, $P_{IV–CG}$
	CCI ≥3 points	61.06 ± 26.30	48.50* ± 30.04	39.58 ± 19.09	66.67 ± 19.09	$P_{II–IV, IV–CG}$
Role-emotional	CCI 0–2 points	72.11 ± 35.40	57.94 ± 39.69	16.67 ± 19.25	81.94 ± 24.04	$P_{II–III, II–IV}$ $P_{III–IV, III–CG}$ $P_{IV–CG}$
	CCI ≥3 points	61.33 ± 29.94	39.13* ± 29.56	19.44 ± 22.29	66.67 ± 57.74	$P_{II-III, II-IV}$ P_{IV-CG}
Mental health	CCI 0–2 points	59.67 ± 10.59	51.81 ± 9.80	49.00 ± 12.81	66.00 ± 10.94	$P_{II–III, II–IV}$ $P_{III–IV, III–CG}$ $P_{IV–CG}$
	CCI ≥3 points	57.08 ± 17.80	43.20 ± 20.46	48.33 ± 11.87	54.67 ± 12.22	$P_{II–III}$

Note: p – independence test; * statistically significant; CG – comparison group; CCI – Charlson Comorbidity Index.

Risk Class II group and the CG. At the same time, in patients in the Risk Class II group with a high CCI, the BP indicator was significantly lower compared to the same indicator in individuals with a low CCI.

The GH indicator was significantly lower in all observation groups with a low CCI. With a high CCI, it was significantly lower only in the Risk Class III and IV groups vs CG. In all observation groups, when comparing the GH indicator to CCI, its values were significantly lower at high CCI compared to low CCI.

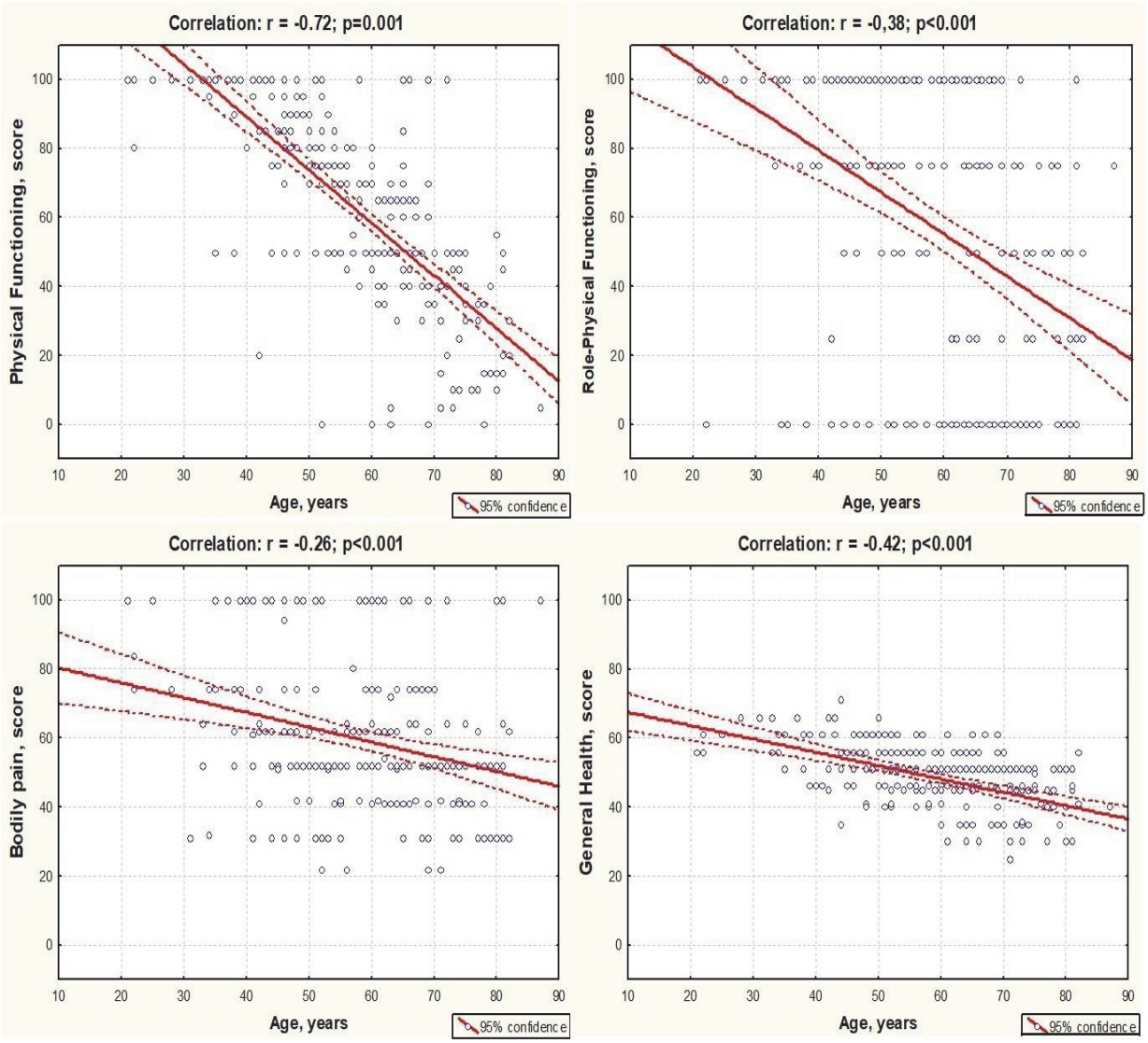
The assessment of MCS in previously hospitalized patients with pneumonia shows that it is significantly lower in individuals who suffered pneumonia of Risk Classes III and IV compared to those who suffered pneumonia of Risk Class II and the CG (Table 3). It is worth noting that all components of mental health, namely VT, SF, RE, and MH, were significantly lower in subjects with pneumonia of Risk Classes III and IV compared to those with pneumonia of Risk Class II and the CG. At the same time, in the Risk Class III group, the SF and RE indicators were significantly higher compared to those who suffered pneumonia of Risk Class IV.

A comparison of the quality-of-life indicators in individuals one year after COVID-19 pneumonia, and depending on the comorbidity burden, showed a significantly lower MCS indicator in subjects who suffered pneumonia of Risk Classes III and IV with both low and high CCI, compared to the Risk Class II group and CG (Table 4). VT in individuals who experienced COVID-19 pneumonia of the Risk Class IV was significantly lower compared to all other observation groups and the CG, regardless of the CCI value. It is worth noting that the VT indicator in individuals with pneumonia of Risk Class III and with a high CCI was significantly lower (by 15.39%) compared to individuals with a low CCI. The SF indicator was the lowest in individuals of the Risk Class IV group. At the same time, the SF indicator in individuals one year after COVID-19 pneumonia of Risk Class III severity with a high CCI was significantly lower (by 23.96%) compared to those with a low CCI. A similar trend was found in the analysis of the RE indicator, where in individuals one year after COVID-19 pneumonia of Risk Class III with a high CCI, this indicator was significantly lower (by 48.07%) compared to individuals with a low CCI. The MH index did not show significant differences between the cohorts of previously hospitalized patients with COVID-19 pneumonia and either high or low CCI.

We also analyzed the effect of age on physical and mental health indicators of individuals one year after COVID-19 pneumonia and found significant correlations between age and PCS indicators. In particular, there was a strong negative correlation with PF, negative correlation with RP and GH, and a weak negative correlation with BP (Chart 1).

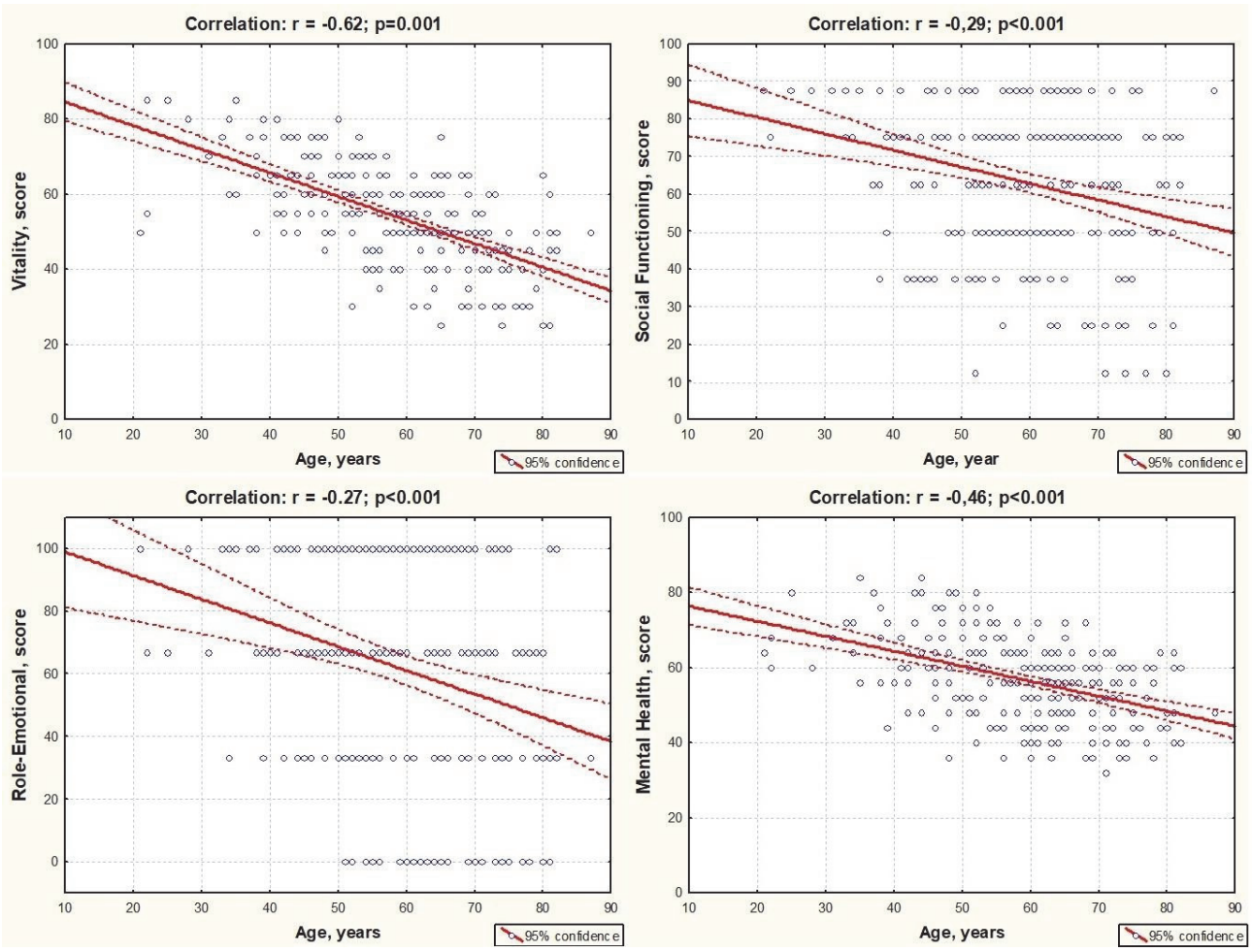
The analysis of individuals' age in relation to MCS indicators also produces significant correlations. In particular, a negative correlation between age and VT and MH, as well as a weak negative correlation between age and SF and RE (Chart 2).

Significant negative correlations were found by comparing the age of the individuals one year after COVID-19 pneumonia to the overall PCS and MCS indicators calculated by the SF-36 questionnaire results. However, the correlation was stronger between age and PCS, while the relationship with MCS was weak (Chart 3).



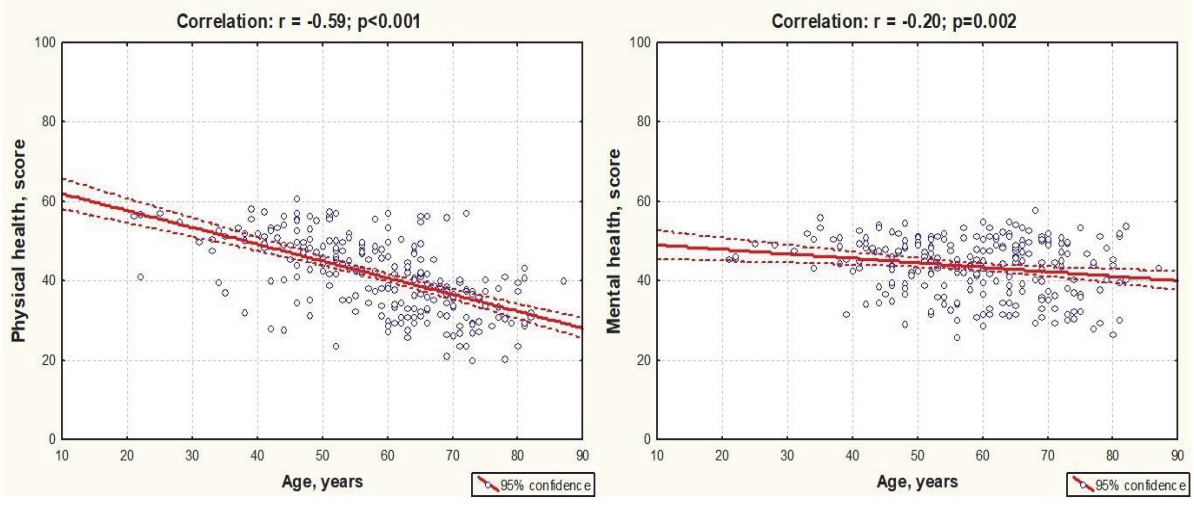
Note: p – independence test.

Chart 1. Relationship between age and physical component summary scores in individuals one year after COVID-19 pneumonia, based on the SF-36 questionnaire results



Note: p – independence test.

Chart 2. Relationship between age and mental component summary scores in individuals one year after COVID-19 pneumonia, based on the SF-36 questionnaire results



Note: p – independence test.

Chart 3. Relationship between age and overall physical component summary and mental component summary scores in individuals one year after COVID-19 pneumonia, based on the SF-36 questionnaire results

Discussion

The global COVID-19 pandemic continues to exert a substantial psychological and physiological burden on individuals and organizations across social and economic communities worldwide. After the acute phase, symptoms or sequelae related to COVID-19 may persist for months and can have a negative impact on HRQOL (Mastrorosa et al., 2023). Previously, in a 1-month follow-up study, Chen et al. (2020) demonstrated that HRQOL was poor among COVID-19 patients.

Compared to the general population in China, the HRQOL of patients with COVID-19 showed a significant difference ($p < 0.05$) in all but the PF indicator of the SF-36 questionnaire. Multiple linear regressions revealed that age was negatively associated with PF and RP, but positively associated with VT ($p < 0.05$). The PF, BP, and RE indicators were negatively associated with female sex ($p < 0.05$). Multivariate analysis demonstrated that the clinical subtype was negatively correlated with PF, GH, RE, and MH. This study highlighted that the more severe the condition of patients, the greater the impact on their physical health and emotional and mental well-being after hospital discharge. Another multicentre follow-up study from China confirmed the substantial effect of COVID-19 on HRQOL, with some effects persisting for more than three months after discharge (Qu et al., 2021).

The present study is the first to conduct a comprehensive follow-up analysis of HRQOL in Ukrainian individuals after COVID-19 pneumonia. Our results found significantly lower PCS and MCS indicators in individuals one year after COVID-19 pneumonia of the Risk Class III and IV compared to those who had COVID-19 pneumonia of the Risk Class II and the CG. At the same time, we found a negative effect of age on both physical and psychological health indicators in individuals one year after COVID-19 pneumonia. In addition, the general health status of individuals one year after COVID-19 pneumonia of both Risk Classes III and IV, as well as Risk Class II with CCI of ≥3 points, was significantly lower compared to those who had CCI of 0–2 points, which indicates a significant impact of comorbidity burden on HRQOL.

Our results are similar to a cross-sectional study from Ethiopia of Kaso et al. (2021), where COVID-19 patients with comorbidity who were older than 55 years and stayed in hospital for more than 15 days had low health quality scores. Saverino et al. (2021) performed an observational study involving adults discharged about a month after a COVID-19-related hospital admission. A total of 35 patients with a mean age of 60 years completed the SF-36. The results showed lingering difficulties across the physical and psychological domains, affecting the return to previous roles and activities. A higher burden of comorbidities, as well as a more severe muscle weakness, was associated with a lower physical functioning. In this study, younger, rather than older age, correlated to greater perceived limitations in physical functioning and vitality.

Temperoni et al. (2021) reported the clinical characteristics and HRQOL in patients with COVID-19 based on retrospective analysis of 673 medical records of the patients who were admitted to the emergency department and using the SF-36 questionnaire.

Among these patients, only 15% were 50 years old or younger. Out of the total number of patients, 74% were discharged to their homes within 48 hours, while 26% required hospitalization. The most commonly observed comorbidities were hypertension (11%), thyroid dysfunction (8%), and neurological and/or mental disorders (6%). After one month from hospital discharge, the HRQOL of these patients was assessed using the SF-36 questionnaire. The outcomes were compared between hospitalized and non-hospitalized patients. Irrespective of hospitalization, both the physical and mental functioning of the patients were found to be impaired.

August et al. (2022) conducted a retrospective analysis of data from 132 patients (with a mean age of 53.8 years) at the University Medical Centre of Freiburg, who continued to experience symptoms for at least 6 months after the initial onset of acute COVID-19.

Among them, 79 (60%) were treated as outpatients, while 53 (40%) required inpatient treatment. The most commonly reported persistent symptoms were fatigue (82%) and dyspnea during exertion (61%). Other frequently reported complaints included difficulties with concentration (54%), insomnia (43%), and smell or taste impairments (35%). The SF-36 questionnaire revealed a reduction in quality of life across all domains, indicating a decrease in functional capacity. At the nearly 1-year follow-up period, individuals who had survived COVID-19 (with a mean age of 51.6 ± 10.8 years) continued to experience various multi-system problems, which affected their respiratory functioning, radiographic results, quality of life, as well as their levels of anxiety and depression, even among those who had experienced non-severe cases. Additionally, a correlation was observed between the scores in all domains of the SF-36 questionnaire and the duration of hospitalisation, pulmonary function, and the results of a six-minute walk test (Zhou et al., 2021).

Kaidar et al. (2022) utilized the SF-36 tool to assess the subjective health status of patients one year after recovering from COVID-19.

The majority (41%) of respondents were over 40 years old, followed by 31% aged 31–40. Nearly half of the participants (46%) reported that their health condition was relatively unchanged compared to a year ago, while 27% rated their health as somewhat worse than before. Interestingly, only one participant (2%) described their condition as much worse than before contracting COVID-19. Some studies aimed to quantify the total mean HRQOL score in patients with "Long COVID-19", which has ranged from (60.4) (Liu et al., 2020) to (86.4) (Guo et al., 2020), where a higher SF-36 score reflects a better health status. Among the patients without comorbidities, the lowest HRQOL score (60.4) was detected in older patients (>65 years), while younger (18–46 years old) patients had the highest HRQOL score (86.4).

Thus recent findings suggest that female sex, old age, the presence and number of comorbidities, severity of illness, lower forced vital capacity, corticosteroids treatment during acute COVID-19, higher body mass index, smoking history, level of education (undergraduate), and employment status (unemployment) are the most frequent determinants of HRQOL in post-COVID-19 patients after hospitalization (Figueiredo et al., 2022; Mastrorosa et al., 2023; Nandasena et al., 2022; Poudel et al., 2021). Recognizing these factors is crucial in developing personalized strategies for the clinical management of patients, aiming to improve their HRQOL.

Limitations

The main limitation of this study is its relatively small sample size. Second, because the study collected self-reported HRQOL data, the individuals might have overestimated or underestimated their health status during the interview. Third, due to the study's cross-sectional design, we could not compare the HRQOL of patients before COVID-19 pneumonia. A compre-

hensive investigation of the physical and mental health of COVID-19 pneumonia patients should also include more specific and diverse evaluation tools, such as the Quality of Life Enjoyment and Satisfaction Questionnaire, Hamilton Anxiety Scale, and Hamilton Depression Scale, which could all add to the accuracy of assessment of physical and mental health status.

Conclusion

According to our study, the presence and number of comorbidities and older age are significantly associated with lower HRQOL in individuals one year after COVID-19 pneumonia. Therefore, prospective monitoring of individuals exposed to SARS-CoV-2 and recognizing potential factors which are associated with poor HRQOL are crucial in understanding the long-term impact of COVID-19 and developing personalized strategies for the clinical management of those subjects aiming to improve their quality of life.

The knowledge gained from this study can help to improve the understanding of the multidisciplinary approach required for the management of HRQOL reduction in COVID-19 survivors and may be a starting point for implementing post-COVID-19 rehabilitation. Considering nurses play a key role in the rehabilitation process, there should be a focus on educating them on determining HRQOL. This would prove to be an important strategy for efficient monitoring and long-term management of COVID-19 survivors.

Ethical statement

The study protocol was approved by the Ethics Committee of I. Horbachevsky Ternopil National Medical University (No. 73, 03.04.2023). It was carried out according to the Data Protection Regulations (GDPR) and the Helsinki Declaration (2013). Patients were only included in the study after they had received full information and given written voluntary consent to participate. All collected information which concerns the health status of patients receives confidentiality protection according to the applicable laws and regulations of Ukraine. Before the study began, the entire research team signed a non-disclosure agreement. At the beginning of the questionnaire, respondents were asked to answer all questions and adhere to GDPR (they did not give their name or workplace).

Data availability

The datasets generated and/or analyzed during the study are available from the corresponding author on reasonable request.

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Conflict of interest

The authors have no conflict of interest to declare.

Vliv zátěže komorbiditou a věku na kvalitu života v kontextu zdraví jedinců jeden rok po zápalu plic způsobeném koronavirem COVID-19

Souhrn

Úvod: Posouzení dlouhodobého dopadu koronaviru 2019 (COVID-19) na fyzickou a psychickou pohodu jednotlivců je zásadní a často se měří prostřednictvím kvality života v kontextu zdraví (HRQOL).

Cíl: Cílem výzkumu bylo prozkoumat subjektivní hodnocení zdravotního stavu pomocí nástroje Short Form 36 Health Survey (SF-36) u osob jeden rok po zápalu plic způsobeném koronavirem COVID-19 a identifikovat dopad zátěže komorbiditou (kvantitativně hodnoceno pomocí Charlsonova indexu komorbidity [CCI]) a věku na ukazatelích fyzického a psychického zdraví.

Metody: Výzkum byl proveden pomocí telefonického průzkumu k vyhodnocení HRQOL 170 jedinců jeden rok po zápalu plic způsobeném koronavirem COVID-19 a 20 jedinců ze srovnávací skupiny (CG).

Výsledky: Výsledky ukazují významně nižší souhrnné ukazatele fyzické a duševní složky u jedinců jeden rok po zápalu plic způsobeném koronavirem COVID-19 III. a IV. rizikové třídy ve srovnání s těmi, kteří měli zápal plic způsobený koronavirem COVID-19 závažnosti II. třídy rizika a CG. Zároveň se ukázal negativní vliv věku na ukazatele fyzického i psychického zdraví. Kromě toho byl celkový zdravotní stav jedinců jeden rok po zápalu plic způsobeném koronavirem COVID-19 ve vztahu k rizikovým třídám III a IV a také rizikovým třídám II s CCI ≥3 bodů významně nižší než u jedinců, kteří měli CCI 0–2 body.

Závěr: Přítomnost a počet komorbidit a vyšší věk významně souvisí s nižší HRQOL u jedinců jeden rok po zápalu plic způsobeném koronavirem COVID-19. Proto je prospektivní sledování jedinců vystavených SARS-CoV-2 a rozpoznání potenciálních faktorů spojených se špatnou HRQOL zásadní pro pochopení dlouhodobého dopadu COVID-19 a pro vývoj personalizovaných strategií pro klinickou léčbu těchto jedinců s cílem zlepšit kvalitu jejich života.

Klíčová slova: COVID 19; komorbidita; kvalita života v kontextu zdraví; výsledky; zápal plic

References

1. August D, Stete K, Hilger H, Götz V, Biever P, Hosp J, Wagner D, et al. (2022). Persistierende Beschwerden 6 Monate nach COVID-19 – Erfahrungen aus der COVID-19-Nachsorgeambulanz des Universitätsklinikums Freiburg [Complaints and clinical findings six months after COVID-19: outpatient follow-up at the University Medical Center Freiburg]. Pneumologie 76(10): 679–688. DOI: 10.1055/a-1546-4291.
2. Brehon K, Niemeläinen R, Hall M, Bostick GP, Brown CA, Wieler M, et al. (2022). Return-to-Work Following Occupational Rehabilitation for Long COVID: Descriptive Cohort Study. JMIR Rehabil Assist Technol 9(3): e39883. DOI: 10.2196/39883.
3. Chen KY, Li T, Gong FH, Zhang JS, Li XK (2020). Predictors of Health-Related Quality of Life and Influencing Factors for COVID-19 Patients, a Follow-Up at One Month. Front Psychiatry 11: 668. DOI: 10.3389/fpsyt.2020.00668.
4. Docherty AB, Harrison EM, Green CA, Hardwick HE, Pius R, Norman L, et al. (2020). Features of 20 133 UK patients in hospital with COVID-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. BMJ 369: m1985. DOI: 10.1136/bmj.m1985.
5. Domingo F, Waddell L, Cheung A, Cooper C, Belcourt V, Zuckermann A, et al. (2021). Prevalence of long-term effects in individuals diagnosed with COVID-19: A living systematic review. MedRxiv preprint, pp. 1–59. DOI: 10.1101/2021.06.03.21258317.
6. Feshchenko YI, Belosludtseva KO, Golubovska OA, et al. (2019). Adapted evidence-based clinical guideline. Nosocomial pneumonia in adults: etiology, pathogenesis, classification, diagnosis, antimicrobial therapy and prevention. Kyiv: National Academy of Medical Sciences of Ukraine. [online] [cit. 2023-01-22]. Available from: http://www.ifp.kiev.ua/ftp1/metoddoc/Pneumonia_guidelines_2019_[rev29].pf
7. Feshchenko Yu I, Mostovoy Yu, Babiychuk Yu (2002). The procedure of adaptation of international quality of life questionnaire MOS SF-36 in Ukraine. The experience of administration in asthma patients. Ukrainian Pulmonology Journal 3: 9–11.
8. Figueiredo EAB, Silva WT, Tsopanoglou SP, Vitorino DFM, Oliveira LFL, Silva KLS, et al. (2022). The health-related quality of life in patients with post-COVID-19 after hospitalization: a systematic review. Rev Soc Bras Med Trop 55: e0741. DOI: 10.1590/0037-8682-0741-2021.
9. Guan W-J, Liang W-H, Zhao Y, Liang H-R, Chen Z-S, Li Y-M, et al. (2020). Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. Eur Respir J 55(5): 2000547. DOI: 10.1183/13993003.00547-2020.
10. Gude-Sampedro F, Fernández-Merino C, Ferreiro L, Lado-Baleato Ó, Espasandín-Domínguez J, Hervada X, et al. (2021). Development and validation of a prognostic model based on comorbidities to predict COVID-19 severity: a population-based study. Int J Epidemiol 50(1): 64–74. DOI: 10.1093/ije/dyaa209.
11. Guo L, Lin J, Ying W, Zheng C, Tao L, Ying B, et al. (2020). Correlation Study of Short-Term Mental Health in Patients Discharged After Coronavirus Disease 2019 (COVID-19) Infection without Comorbidities: A Prospective Study. Neuropsychiatr Dis Treat 16: 2661-2667. DOI: 10.2147/NDT.S278245.
12. Haupt TH, Petersen J, Ellekilde G, Klausen HH, Thorball CW, Eugen-Olsen J, et al. (2012). Plasma suPAR levels are associated with mortality, admission time, and Charlson Comorbidity Index in the acutely admitted medical patient: a prospective observational study. Crit Care 16(4): R130. DOI: 10.1186/cc11434.
13. Kaidar E, Turgambayeva A, Kassymova S (2022). Assessment of quality of life one year after in COVID-19 cases using the SF-36. J Clin Med Kaz 19(6): 13–17. DOI: 10.23950/jcmk/12644.
14. Kamyshnyi A, Krynytska I, Matskevych V, Marushchak M, Lushchak O (2020). Arterial Hypertension as a Risk Comorbidity Associated with COVID-19 Pathology. Int J Hypertens 2020: 8019360. DOI: 10.1155/2020/8019360.
15. Karako K, Song P, Chen Y, Karako T (2022). Trends in managing COVID-19 from an emerging infectious disease to a common respiratory infectious disease: What are the subsequent impacts on and new challenges for healthcare systems? Biosci Trends 16(6): 381–385. DOI: 10.5582/bst.2022.01526.
16. Kaso AW, Agero G, Hurisa, Z, Kaso T, Ewune HA, Hailu A (2021). Evaluation of health-related quality of life of COVID-19 patients: a hospital-based study in South Central Ethiopia. Health Qual Life Outcomes 19(1): 268. DOI: 10.1186/s12955-021-01900-y.
17. Kinross P, Suetens C, Dias JG, Alexakis L, Wijermans A, Colzani E, et al. (2020). Rapidly increasing cumulative incidence of coronavirus disease (COVID-19) in the European Union/European Economic Area and the United Kingdom, 1 January to 15 March 2020. Euro Surveill 25(11): 2000285. DOI: 10.2807/1560-7917.ES.2020.25.11.2000285.
18. Krynytska I, Marushchak M, Birchenko I, Dovgalyuk A, Tokarskyy O (2021). COVID-19-associated acute respiratory distress syndrome versus classical acute respiratory distress syndrome (a narrative review). Iran J Microbiol 13(6): 737–747. DOI: 10.18502/ijm.v13i6.8072.
19. Lins L, Carvalho FM (2016). SF-36 total score as a single measure of health-related quality of life: Scoping review. SAGE Open Med 4: 2050312116671725. DOI: 10.1177/2050312116671725.
20. Liu K, W Zhang, Y Yang, J Zhang, Y Li, Y Chen (2020). Respiratory rehabilitation in elderly patients with COVID-19: A randomized controlled study. Complement Ther Clin Pract 39: 101166. DOI: 10.1016/j.ctcp.2020.101166.
21. Mastrorosa I, Del Duca G, Pinnetti C, Lorenzini P, Vergori A, Brita AC, et al. (2023). What is the impact of post-COVID-19 syndrome on health-related quality of life and associated factors: a cross-sectional analysis. Health Qual Life Outcomes 21(1): 28. DOI: 10.1186/s12955-023-02107-z.
22. Megari K (2013). Quality of Life in Chronic Disease Patients. Health Psychol Res 1(3): e27. DOI: 10.4081/hpr.2013.e27.
23. Melendi SE, Pérez MM, Salas CE, Haedo MF, Xavier FB, Saltos Navarrete JD, et al. (2020). COVID-19 with and without pneumonia: clinical outcomes in the internal medicine ward. Medicina (B Aires) 80(Suppl. 6): 56–64.
24. Nandasena H, Pathirathna ML, Atapattu AMMP, Prasanga PTS (2022). Quality of life of COVID 19 patients after discharge: Systematic review. PloS One 17(2): e0263941. DOI: 10.1371/journal.pone.0263941.
25. NICE Guideline 191: Pneumonia: Diagnosis and management of community- and hospitalacquired pneumonia in adults 2014 (updated 2022). [online] [cit. 2023-08-22]. Available from: https://www.nice.org.uk/guidance/cg191
26. Poudel AN, Zhu S, Cooper N, Roderick P, Alwan N, Tarant C, et al. (2021). Impact of COVID-19 on health-related quality of life of patients: A structured review. PloS One 16(10): e0259164. DOI: 10.1371/journal.pone.0259164.
27. Qu G, Zhen Q, Wang W, Fan S, Wu Q, Zhang C, et al. (2021). Health-related quality of life of COVID-19 patients after discharge: A multicenter follow-up study. J Clin Nurs 30: 1742–1750. DOI: 10.1111/jocn.15733.
28. Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, et al. (2011). Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. Am J Epidemiol 173(6): 676–682. DOI: 10.1093/aje/kwq433.
29. Saverino A, Zsirai E, Sonabend R, Gaggero L, Cevasco I, Pistarini C, et al. (2021). Health related quality of life in COVID-19 survivors discharged from acute hospitals: results of a short-form 36-item survey [version 1; peer review: 1 approved]. F1000Research 10: 282. DOI: 10.12688/f1000research.50781.1.
30. Soriano JB, Murthy S, Marshall JC, Relan P, Diaz JV, WHO Clinical Case Definition Working Group on Post-COVID-19 Condition (2022). A Clinical Case Definition of Post COVID-19 Condition by a Delphi Consensus. Lancet Infect Dis 22(4): e102–e107. DOI: 10.1016/S1473-3099(21)00703-9.
31. Temperoni C, Grieco S, Pasquini Z, Canovari B, Polenta A, Gnudi U, et al. (2021). Clinical characteristics, management and

health related quality of life in young to middle age adults with COVID-19. BMC Infect Dis 21(1): 134. DOI: 10.1186/s12879-021-05841-1.

32. Worldometer: COVID Live – Coronavirus Statistics (2022). [online] [cit. 2023-09-07]. Available from: https://www.worldometers.info/coronavirus/
33. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. Lancet 395(10229): 1054–1062. DOI: 10.1016/S0140-6736(20)30566-3.
34. Zhou F, Tao M, Shang L, Liu Y, Pan G, Jin Y, et al. (2021). Assessment of Sequelae of COVID-19 Nearly 1 Year After Diagnosis. Front Med (Lausanne) 8: 717194. DOI: 10.3389/fmed.2021.717194.