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Quality of life and professional wellbeing of Portuguese nurses during the COVID-19 pandemic: a longitudinal study

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Abstract

Background Several studies have indicated that the COVID-19 pandemic has had an impact on nurses' psychological and physical quality of life (QoL), as well as on their professional well-being. The literature also indicates that perceived stress, resilience, social support, the psychosocial work environment and professional identification may be determinants of these variables. However, no studies have examined how these determinants may influence nurses' psychological and physical QoL or professional well-being throughout the COVID-19 pandemic. Thus, this study aimed to investigate the influence the influence of perceived stress, resilience, perceived social support, the psychosocial work environment and professional identification on Portuguese nurses' professional well-being and physical and psychological QoL throughout the COVID-19 pandemic.

Methods For this longitudinal study, data were collected through self-administered questionnaires focused on QoL, professional well-being, and sociodemographic characteristics. The data collection spanned three distinct time points, from November 2021 to June 2023. Data Analysis was conducted by utilizing random-intercept linear regression models.

Results A total of 555 responses were analyzed at all of the measurement points (340 responses at T0, 122 at T1, and 93 at T2), and compared to those at T0, physical and psychological QoL increased at T2. Perceived stress and support from colleagues diminished at T2 compared to T0. During the COVID-19 pandemic, participants who reported low perceived stress, high resilience, high social support from supervisors, high social support from colleagues, and/or high job satisfaction tended to report greater professional well-being and physical and psychological QoL.

Conclusions Throughout the COVID-19 pandemic, perceived stress consistently negatively influenced nurses' professional well-being and physical and psychological QoL; moreover, resilience and job satisfaction were consistently significant positive determinants of all outcomes. These insights highlight the need for targeted interventions to reduce stress, enhance resilience, and foster job satisfaction among nurses, thus ultimately improving

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their QoL, professional well-being and effectiveness in health care delivery, particularly during high-stress periods such as pandemics. Future research should explore how these stressors and protective factors influence nurses' QoL and professional well-being.

Keywords Quality of life, Professional well-being, Workplace, Health, Nurses, COVID-19, Pandemics, Determinants, Salutogenesis

Background

The coronavirus disease 2019 (COVID-19) pandemic is a global outbreak of coronavirus, which is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. Cases of novel coronavirus were first detected in China in December 2019, with the virus spreading rapidly to other countries worldwide [1]. This led the World Health Organization (WHO) to declare a Public Health Emergency of International Concern on January 30th, 2020, and to characterize the outbreak as a pandemic on March 11th, 2020 [1].

Due to the characteristics of this disease and the number of people necessitating medical attention within a condensed timeframe, health care systems have experienced substantial strain. This has significantly affected health care workers worldwide. Several studies have indicated that the COVID-19 pandemic has impacted the quality of life (QoL) of health care workers [2–5]. According to the WHO, quality of life is defined as "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and concerning their goals, expectations, standards and concerns". It is a broad-ranging concept incorporating people's psychological state and physical health in a complex manner. This definition reflects the view that QoL refers to a subjective evaluation embedded in a cultural, social and environmental context [6]. For example, a systematic review published in 2023 on the impact of the COVID-19 pandemic on the QoL of health care workers indicated that COVID-19 frontline workers perceived lower QoL, which was mainly associated with psychological states such as depression, anxiety and stress [3]. However, the impact of the COVID-19 pandemic was not exclusive to health care workers' psychological states; it also seemed to have affected their physical health, as they tended to feel increased fatigue (less energy) throughout the COVID-19 pandemic [4].

The literature also indicates that health care workers' professional well-being (or workplace well-being) tended to be impacted by the COVID-19 pandemic [7–9]. Professional well-being is related to the broader concept of psychological well-being (or subjective well-being), which stems from various life and nonwork sources of satisfaction individuals enjoy [10]. Professional well-being is further conceptualized as job-related and is a function of being satisfied with one's job, finding meaning in one's work, feeling engaged while at work, having a high-quality working life, and finding professional fulfilment in one's work [11, 12].

Several studies have provided concrete evidence that nurses had poorer mental health outcomes than medical doctors during the COVID-19 pandemic [13]. This is especially true for symptoms of depression, anxiety and post-traumatic stress disorder. In this scenario, the prevalence rates among nurses are often greater than 50%. In contrast, general stress levels and burnout seem comparable between nurses and medical doctors [13].

According to the literature, some factors, such as perceived stress, resilience, perceived social support, the psychosocial work environment (which includes features such as, for instance, the influence at work [decision latitude], social support, skill discretion, psychological demands, job security and levels of organizational justice [14]) and professional identification, may act as determinants of psychological and physical QoL and professional well-being. Some studies performed during the COVID-19 pandemic have indicated that perceived stress is a significant predictor of nurses' QoL [15]; moreover, resilience is a critical factor that positively influences health care workers' QoL [16]. Furthermore, perceived social support is significantly related to all dimensions of professional QoL in emergency nurses [17], and poor psychosocial work conditions are significantly associated with an increased risk of mental disorders among health care workers [15]. Additionally, professional identification positively correlates with health care workers' satisfaction and negatively correlates with burnout [18]. However, to our knowledge, no studies have comprehensively examined how various determinants—such as perceived stress, resilience, perceived social support, psychosocial work environment, and professional identification—may have influenced nurses' psychological and physical QoL or professional well-being throughout the COVID-19 pandemic. This knowledge gap is particularly striking in the Portuguese context, where no research has systematically investigated these factors and their influence during the pandemic. Existing studies have demonstrated significant mental health challenges among Portuguese nurses, including elevated levels of depression, anxiety, stress, and poorer sleep quality compared to the general population [19–21]. However, these studies have primarily focused on isolated outcomes or lacked a longitudinal perspective, failing to explore the broader

interplay of these critical factors influencing nurses' QoL and well-being.

The objective of this study was to investigate how perceived stress, resilience, perceived social support, psychosocial work environment, and professional identification impacted the physical and psychological QoL, as well as the professional well-being of Portuguese nurses throughout the COVID-19 pandemic. By doing so, this research not only builds on prior findings but also seeks to further explore the unique challenges that healthcare professionals in Portugal faced during this unprecedented global crisis. This study fills the gap in the research by taking a comprehensive and integrative approach to examine how various factors influenced the psychological and physical QoL and professional well-being of Portuguese nurses during the pandemic.

These contributions underscore the originality, novelty, and significance of the research, offering a deeper understanding of nurses' quality of life and well-being while informing strategies to better support them in future public health emergencies.

Theoretical framework

Based on this background, our research used the Neuman Systems Model (NSM) [22]. This theory provided a theoretical framework for investigating several aspects: first, an exploration of the stressors impacting population health; second, elucidation of the correlation between these stressors and the evolution of both physical and psychological QoL, along with professional well-being; and third, examination of strategies employed for maintaining health due to these stressors. This framework adopts a comprehensive view of human beings, focusing on their overall well-being and specific responses to stressors [22]. The selection of this framework for our study was predicated on three primary considerations that are particularly relevant for nurses during the COVID-19 pandemic: (i) it initially treats stressors as being neutral; (ii) it does not presuppose a negative association between exposure to stressors and health outcomes; and (iii) it employs a salutogenic perspective which focus on the origins of health and health benefits, versus the origins of disease and risk factors [23] thus aiding in the identification of health-promoting factors amidst various stressor exposures.

Methods

Design and population

A longitudinal study with three time points was conducted in Portugal as part of a larger longitudinal research project investigating nurses' QoL and professional wellbeing in other European countries (Switzerland, France, and Belgium) and Canada [24–27]. Multiple COVID-19 waves have existed from November 2021 to June 2023. The first survey was conducted from November 2021 to January 2022. At the end of the first survey, the total number of cumulative COVID-19 cases in Portugal increased to 3 million, hospitalized patients increased from 372 to 2,469, and the number of cumulative deaths was approximately 20,000 [28, 29]. The second survey occurred between September 2022 and October 2022. At this time, the number of cumulative cases had almost doubled (5.5 million), and the number of deaths had increased to 25,000 [29]. The number of hospitalized patients increased from 446 to 525 (ESRI Portugal, 2024). The third period was between May 2023 and June 2023 [29]. At this time point, the total number of cases and deaths had not increased at the same rate as before (5.6 million and 26,000, respectively), which was mainly because more than 90% of the Portuguese population had already been vaccinated against COVID-19 since March 2022 [29]. No data were available on the number of patients hospitalized during period because, as of November 7th, 2022, Portugal's Directorate General for Health stopped presenting that information [28].

During the initial survey and to maximize the number of participants, an invitation with a link to participate in an online self-administered questionnaire was disseminated on the official website of the Portuguese Council of Nurses (Ordem dos Enfermeiros [OE]). Participants willing to participate during the second and third surveys were asked to provide their emails. Data coding was implemented such that only the researchers who were responsible for contacting participants at the second and third phases of data collection could access their email addresses. To associate participants' responses across various data collection phases, unique random alphanumeric identifiers created by the survey software were utilized. Completion of the questionnaire required approximately 30 min. Participating nurses had to meet the following inclusion criteria: were engaged in clinical practice in Portugal, held regular work contracts, were working half-time or more, and were fluent in Portuguese. Participants were excluded if they had only a management position, had only student status, and/or had only teaching status. During data collection, the OE totaled between 80,239 members and 81,799 members [30]. The data were collected by using Sphinx IQ2 at pH 7.2.0.2.

This manuscript was reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cohort studies [31].

Measures

Two specific domains of the World Health Organization Quality of Life-BREF (WHOQOL-BREF) [32] were used to evaluate physical and psychological QoL. The

assessment of Professional well-being was conducted using the Psychological Wellbeing Scale adapted for workplace settings by Fisher [33]. To assess QoL and professional well-being determinants, instruments such as the Perceived Stress Scale (PSS) [34], the 10-item Connor-Davidson Resilience Scale (CD-RISC) [35], the Multidimensional Scale of Perceived Social Support (MSPSS) [36], the Copenhagen Psychosocial Questionnaire (COPSOQ) [37], and a single professional identification item were utilized. Furthermore, sociodemographic characteristics were analyzed using a customized sociodemographic questionnaire.

The WHOQOL-BREF [32] is a questionnaire of 26 items structured around four distinct domains, namely physical health, psychological health, social relations, and environment. In the context of the current research, the investigation focused solely on evaluating the physical and psychological domains. This questionnaire was developed to evaluate an individual's self-perceived Quality of Life (QoL). Participants rate each item on a five-point scale, ranging from "not at all" to "completely". In line with the guidelines provided by the creators of the questionnaire, the average scores obtained were converted to a standardized scale ranging from 0 (poor QoL) to 100 (good QoL). The psychometric properties of the instrument in its Portuguese version are robust, indicated by Cronbach's alphas surpassing the threshold of 0.70 across all dimensions [38].

The Psychological Wellbeing Scale, initially developed by Diener et al. [28] and modified for professional environments by Fisher [33], consists of eight elements to assess self-perceived functioning in domains such as self-esteem, purpose, and relationships. Items are evaluated using a five-point Likert scale ranging from 1 (poor wellbeing at work) to 5 (strong wellbeing at work) [39]. This scale was translated into Portuguese utilizing the approach outlined by Wild et al. [36] and demonstrated a Cronbach's alpha coefficient falling within the range of 0.84 to 0.88.

The PSS, which was originally developed by Cohen et al. [34], is employed to assess how life situations in the past month were perceived in terms of being unpredictable, threatening, painful, and uncontrollable. The Portuguese version was translated and validated by Reis et al. [40]. In this 10-item instrument, the participants rate items on a scale from 0 (never) to 4 (very often) [34]. This scale exhibits psychometric solid properties, with a Cronbach's alpha of 0.87 [40].

The CD-RISC was developed by Campbell-Sills [35] and was translated and validated in Portuguese by Faria Anjos et al. [41]. It measures one's ability to bounce back from life's challenges [35]. A five-point Likert scale from 0 (not at all true) to 4 (true nearly all the time) [35] is used for rating. In the Portuguese version, it obtained a Cronbach's alpha above 0.80 [41].

The MSPSS [36] has 12 items rated on a Likert scale from 1 (disagree completely) to 7 (agree completely) [36]. It was created to evaluate perceived social support from family, friends, and significant others. The Portuguese version presents good psychometric properties with Cronbach's alpha ranging from 0.87 to 0.95 [42].

The COPSOQ uses 24 core dimensions spanning four aspects of work: work environment, health, well-being, and personality to assess psychosocial risks in the workplace [37]. For this study, we selected three dimensions: social support from colleagues (3 items), social support from supervisors (3 items), and job satisfaction (2 items) [37]. Items are rated on a five-point Likert scale from 1 (always) to 5 (never/hardly ever) for the two social support dimensions and from 1 (to a very large extent) to 5 (to a minimal extent) for the job satisfaction dimension [37]. The Portuguese version has demonstrated solid psychometric properties, with Cronbach's alphas ranging from 0.75 to 0.86 for the three selected dimensions [43].

Postmes et al. [44] developed a single-item measure of professional identification ("In the present context, I align myself with fellow nurses carrying out similar tasks to mine."), to assess professional identification. The participants can rate the single item on a scale from 1 (completely disagree) to 7 (completely agree). Translating this single measure into Portuguese followed the Wild et al. [45] methodology.

The socio-demographic and professional questionnaire was developed for the European multicentric study mentioned above [24–27] and adapted to the Portuguese context [27]. It encompasses multiple personal characteristics such as sex, age, and professional dimensions, including employment status, unit reassignment, and level of exposure to COVID-19.

Data analysis

Observations with less than a 90% response rate were removed, as were participants who did not work in a clinical setting, who worked less than half a week, and who did not work in Portugal. Overall, 51 observations were removed at T0, 35 at T1, and 57 at T2, thus resulting in 340 observations that could be analyzed at T0, 122 at T1, and 93 at T2, which totaled 555 observations. All variables were treated as continuous, with the exception of sociodemographic variables, which were categorized as either dichotomous (two categories) or discrete (three or more categories). Descriptive statistics were calculated for all variables at each measurement point. The evolution of the scores over time was assessed through random-intercept linear regression models testing the association with measurement time. Linearity and normality assumptions were checked before using

Table 1 Descriptive statistics for the study sample

		N			Frequency (%)		
Variable	**Modality**	**T0**	**T1**	**T2**	**T0**	**T1**	**T2**
Sex	Woman	285	98	67	83.8	80.3	72.0
	Man	54	22	23	15.9	18.0	24.7
	Prefers not to self-describe	0	1	1	0.0	0.8	1.1
Age	18–29	41	9	5	12.1	7.4	5.4
	30–39	112	39	27	32.9	32.0.	29.0
	40–49	111	35	22	32.6	28.7	23.7
	50+	76	38	39	22.4	31.1	41.9
COVID-19 exposure	None	92	14	7	27.1	11.5	7.5
	Indirect	168	76	59	49.4	62.3	63.4
	Direct	79	32	26	23.2	26.2	28.0
Unit reassignment	None	194	70	54	57.1	57.4	58.1
	Short (< = 1 month)	37	15	10	10.9	12.3	10.8
	Long (> 1 month)	71	23	17	20.9	18.9	18.3
	Multiple	33	11	9	9.7	9.0	9.7

Some frequencies may not add up to 100% because of nonresponses

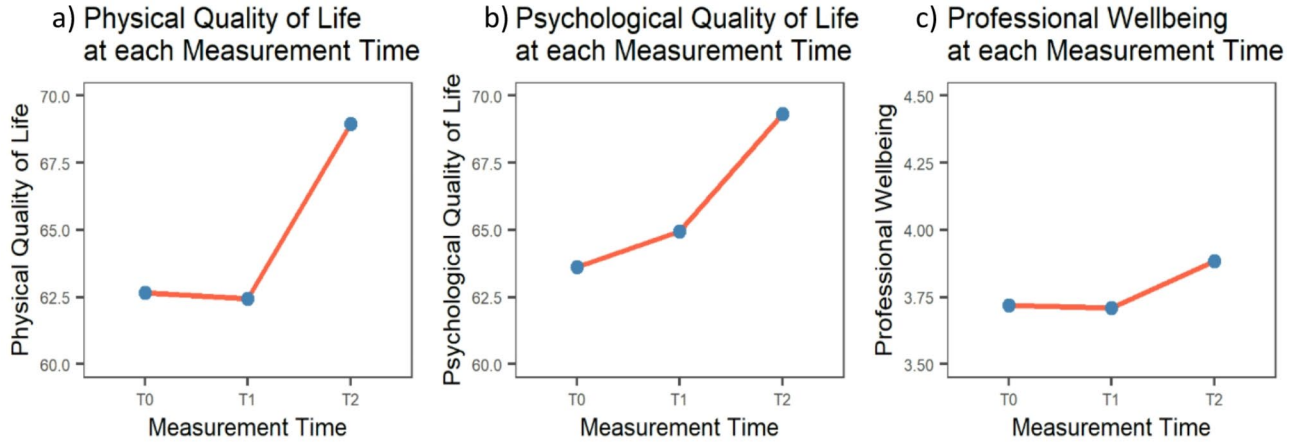

Fig. 1 Variables that changed significantly between measurement times

hierarchical random-intercept linear regression models for three outcomes: physical QoL, psychological QoL, and professional well-being. Multilevel modeling allowed for the creation of models even when some participants had missing responses at certain time points [46]. To facilitate model comparisons, missing values (0.31% of the dataset) were imputed using the mean for numerical variables and the mode for categorical variables. Numerical variables were standardized to enable coefficient comparisons. Predictors were added incrementally: Block 1 included measurement point effects; Block 2 incorporated sociodemographic variables; and Block 3 included stressors and protective factors. Model comparisons were based on deviance values. The models were developed using R 4.2.2 and the lme4 package (v.1.1–31) [47]. Variance inflation factor (VIF) analyses indicated no issues with multicollinearity among the dependent variables (all VIFs < 3) [48]. Statistical significance was determined at $p < .05$.

Results

Descriptive statistics

Sociodemographic characteristics

A total of 555 observations were included in the analyses: 340 at T0, 122 at T1, and 93 at T2. Table 1 presents descriptive statistics for the study sample. Across all of the measurement times, participants were mostly female (72.0-83.8%), and the age distribution was globally close between 30 and 39, 40–49, and 50 years or older (23.7–41.9%), whereas 18–29 years were less common (5.4–12.1%). Finally, most participants had indirect contact with COVID-19 (49.4–63.4%) and were not reassigned to new units during the pandemic (57.1–58.1%).

Outcomes, protective factors and stressors

As shown in Fig. 1, physical QoL, psychological QoL, and professional well-being exhibited statistically significant improvements at the second time point (T2) compared to the baseline (T0), with coefficients and *p* values

of β = 0.18, p =.009; β = 0.18, p =.012; and β = 0.22, p =.007, respectively (Table 2).

As Table 2 shows, support from colleagues decreased at T2 compared to T0 (β = 0.21, p =.014). Additionally, perceived stress was found to be significantly lower at both T1 (β = -0.22, p =.001) and T2 (β = -0.31, p <.001) than at T0. A noteworthy fluctuation was observed in professional identification, which decreased at T1 (β = -0.24, p =.006) but increased at T2. No other statistically significant variations were observed over time in the study. The reliability of all of the variables was confirmed, with each variable demonstrating at least satisfactory Cronbach's alpha values (α > 0.7) at all of the measurement points.

Hierarchical Random-Intercept linear regression models

Table 3 presents the results of the hierarchical random-intercept linear regression models with physical QoL, psychological QoL, and professional well-being as outcomes.

Physical QoL

Block 1 significantly improved the physical QoL model compared to the intercept-only model (χ^2_2 = 7.60, p =.022). Physical QoL was greater at T2 than at T0 (β = 0.18, p =.009). Block 2 also significantly improved the quality of the model (χ^2_{10} = 21.84, p =.016), with men reporting greater physical QoL than women (β = 0.56, p <.001). These effects did not remain significant after Block 3 was added, which suggests that they can be explained by the variables in Block 3. Block 3 improved the model significantly (χ^2_7 = 307.33, p <.001). Participants who reported low perceived stress (β = -0.43, p <.001), high resilience (β = 0.11, p =.004), high social support (β = 0.15, p <.001), and/or high job satisfaction (β = -0.14, p <.001) tended to report of greater physical QoL.

Psychological QoL

Compared with the intercept-only model, Block 1 significantly improved the psychological QoL model (χ^2_2 = 6.88, p =.032). Psychological QoL was greater at T2 than T0 (β = 0.18, p =.012). Block 2 did not improve the model significantly (χ^2_{10} = 14.88, p =.137), although men displayed greater psychological QoL than women (β = 0.41, p =.003). Block 3 improved the model significantly (χ^2_7 = 493.77, p <.001). Participants who reported low perceived stress (β = -0.46, p <.001), high resilience (β = 0.17, p <.001), high social support (β = 0.23, p <.001), and/or high job satisfaction (β = -0.14, p <.001) tended to report of greater psychological QoL.

Professional well-being

Compared with the intercept-only model, Block 1 significantly improved the professional well-being model (χ^2_2 = 7.95, p =.019). Professional well-being was greater at T2 than T0 (β = 0.22, p =.007). Block 2 did not improve the model significantly (χ^2_{10} = 15.65, p =.110). Block 3 improved the model significantly (χ^2_8 = 427.82, p <.001). Participants who reported low perceived stress (β = -0.22, p <.001), high resilience (β = 0.20, p <.001), high social support from supervisors (β = -0.07, p =.039), high social support from colleagues (β = -0.19, p <.001), and/or high job satisfaction (β = -0.33, p <.001) tended to report of greater professional well-being.

Discussion

This study examined the influence of demographic and professional variables, perceived stress, resilience, perceived social support, the psychosocial work environment and professional identification on Portuguese nurses' professional well-being and physical and psychological QoL throughout the COVID-19 pandemic. According to the findings and among all of the demographic factors, only sex tended to influence Portuguese nurses' professional well-being throughout the COVID-19 pandemic. In contrast, perceived stress consistently had a negative influence on nurses' professional well-being and physical and psychological QoL. Resilience and job satisfaction were consistently significant positive determinants of all outcomes.

Sociodemographic and professional characteristics

Our sample comprised of 340 nurses at T0, 122 at T1, and 93 at T2. Most of them (72.0-83.8%) were female nurses, which is similar to current Portugal national statistics, wherein 69,079 (82.7%) of 83,538 nurses are female [49]. Additionally, the age distribution in the sample was globally close to 30–39, 40–49, and 50 years or older; in Portugal, most of the nurses were aged 26–45 years (47,457); therefore, this characteristic of the sample is also similar to current national statistics for Portugal [49]. Nonetheless, due to our data collection procedure (which involved posting a link to participate in an online self-administered questionnaire on the website of the OE), which was the most common strategy during the COVID-19 pandemic [50], it was not possible to ensure the representativeness of the sample.

Outcomes and determinants

In our study, all of the outcomes (physical QoL, psychological QoL and professional well-being) exhibited statistically significant improvements at the second timepoint (T2) compared to the baseline (T0). This improvement may be because data collection for T2 was performed between May and June 2023; on the 5th of May 2023, the WHO Director-General declared COVID-19 a global health emergency [51]. Another potential explanation for the improvement in all of the outcomes between T0 and T2 may be the progressively lower pressure related

Table 2 Descriptive statistics for numerical variables

		Data collection			Multilevel model standardized coefficient	
Variables		**T0**	**T1**	**T2**	**T0 vs. T1**	**T0 vs. T2**
Outcomes						
Quality of life: physical	N	340	122	93	β = 0.00, *p* = .995	β = 0.18, *p* = .009**
	Mean	62.67	62.43	68.96		
	SD	18.34	19.31	15.83		
	Max	100.00	100.00	100.00		
	Min	10.71	7.14	25.00		
	α	0.86	0.89	0.83		
Quality of life: psychological	N	340	122	93	β = 0.09, *p* = .164	β = 0.18, *p* = .012*
	Mean	63.62	64.95	69.31		
	SD	18.05	18.12	16.66		
	Max	100.00	100.00	100.00		
	Min	12.50	16.67	25.00		
	α	0.87	0.87	0.86		
Professional wellbeing	N	340	122	93	β = 0.00, *p* = .999	β = 0.22, *p* = .007**
	Mean	3.72	3.71	3.88		
	SD	0.63	0.60	0.63		
	Max	5.00	5.00	5.00		
	Min	3.25	3.12	2.25		
	α	0.84	0.84	0.88		
Determinants						
Resilience	N	340	122	93	β = -0.04, *p* = .515	β = 0.05, *p* = .485
	Mean	3.52	3.50	3.58		
	SD	0.69	0.69	0.76		
	Max	5.00	5.00	5.00		
	Min	1.70	1.50	1.30		
	α	0.90	0.91	0.94		
Support from colleagues†	N	340	122	93	β = 0.13, *p* = .084	β = 0.21, *p* = .014*
	Mean	2.84	3.01	3.08		
	SD	1.00	0.94	1.10		
	Max	6.00	5.67	6.00		
	Min	1.00	1.00	1.00		
	α	0.84	0.75	0.91		
Support from hierarchy†	N	340	122	92	β = 0.02, *p* = .808	β = -0.09, *p* = .265
	Mean	3.92	3.94	3.78		
	SD	1.33	1.29	1.27		
	Max	6.00	6.00	6.00		
	Min	1.00	1.00	1.00		
	α	0.92	0.91	0.94		
Job Satisfaction†	N	339	122	92	β = 0.03, *p* = .652	β = -0.09, *p* = .275
	Mean	3.13	3.16	2.95		
	SD	0.92	1.01	0.85		
	Max	5.00	5.00	5.00		
	Min	1.00	1.00	1.00		
	α	0.82	0.87	0.82		
Social support	N	339	122	93	β = -0.07, *p* = .214	β = -0.07 *p* = .259
	Mean	5.68	5.63	5.75		
	SD	1.09	1.15	0.96		
	Max	7.00	7.00	7.00		
	Min	1.00	1.92	1.83		
	α	0.94	0.94	0.93		

Table 2 (continued)

		Data collection			Multilevel model standardized coefficient	
Variables		**T0**	**T1**	**T2**	**T0 vs. T1**	**T0 vs. T2**
Outcomes						
Perceived stress	N	340	122	93	β = -0.22, *p* =.001**	β = -0.31, *p* <.001***
	Mean	3.03	2.90	2.78		
	SD	0.63	0.59	0.57		
	Max	4.54	4.31	4.08		
	Min	1.00	1.62	1.31		
	α	0.91	0.90	0.89		
Professional identification	N	340	122	93	β = -0.24, *p* =.006**	β = -0.01, *p* =.915
	Mean	4.92	4.58	4.85		
	SD	1.32	1.33	1.15		
	Max	7.00	7.00	7.00		
	Min	1.00	1.00	2.00		

*: *p* <.050; **: *p* <.010; ***: *p* <.001. †Reversed variables: low scores indicate high support or satisfaction. SD: Standard deviation; α: Cronbach's alpha coefficient

Table 3 Hierarchical random-intercept linear regression models

Block	**Variables**	**Physical QoL**		**Psychological QoL**		**Professional Well-being**	
		β	**se**	**β**	**se**	**β**	**se**
Block 1	Measurement point: T1	-0.08	0.06	-0.01	0.05	-0.01	0.06
	Measurement point: T2	0.08	0.06	0.04	0.06	0.12	0.07
	Change in deviance	$\chi^2(2) = 7.60$* *p* =.022		$\chi^2(2) = 6.88$* *p* =.032		$\chi^2(2) = 7.95$* *p* =.019	
Block 2	Sex: Man	0.19	0.10	-0.01	0.08	-0.17*	0.09
	Sex: Self-describe	0.06	0.39	0.04	0.34	-0.77	0.42
	Age: 30–39	-0.03	0.12	-0.01	0.10	0.01	0.11
	Age: 40–49	-0.23*	0.12	-0.01	0.10	0.03	0.11
	Age: ≥ 50	-0.23	0.12	0.00	0.10	0.17	0.11
	COVID-19 exposure: Indirect	-0.05	0.07	0.10	0.06	0.04	0.07
	COVID-19 exposure: Direct	0.01	0.09	0.05	0.08	0.06	0.09
	Reassignment: Short	0.09	0.10	0.04	0.08	-0.04	0.09
	Reassignment: Long	0.03	0.08	-0.04	0.07	-0.10	0.07
	Reassignment: Multiple	0.01	0.10	0.05	0.08	-0.05	0.10
	Change in deviance	$\chi^2(10) = 21.84$* *p* =.016		$\chi^2(10) = 14.88$ *p* =.137		$\chi^2(10) = 15.65$ *p* =.110	
Block 3	Perceived stress	-0.43***	0.04	-0.46***	0.03	-0.22***	0.04
	Resilience	0.11**	0.04	0.17***	0.03	0.20***	0.04
	Perceived social support	0.15***	0.04	0.23***	0.03	0.04	0.03
	Social support from supervisors†	0.00	0.04	0.03	0.03	-0.07*	0.03
	Social support from colleagues†	-0.03	0.04	-0.05	0.03	-0.19***	0.04
	Job satisfaction†	-0.14***	0.04	-0.14***	0.03	-0.33***	0.04
	Professional identification	-0.03	0.03	-0.02	0.03	0.01	0.03
	Change in deviance	$\chi^2(7) = 307.33$*** *p* <.001		$\chi^2(7) = 493.77$*** *p* <.001		$\chi^2(7) = 427.82$*** *p* <.001	

QoL: Quality of life; β: standardized regression coefficient; se: standard error. *p*: 0 '***' 0.001; '**' 0.010; '*' 0.050. † Reversed variables: low scores indicate high support or satisfaction. All of the standardized regression coefficients are from the complete analyses that included all of the blocks.

to the COVID-19 pandemic, which was experienced in healthcare services in Portugal over time. Indeed, the number of patients who were hospitalized in Portugal due to COVID-19 in T0 ranged from 372 to 2,469 (there was a massive increase in the number of hospitalizations due to COVID-19 in Portugal from November 2021 to January 2022) and from 446 to 525 in T1; moreover, on the 7th of November 2022, the Portugal Directorate General of Health stopped presenting data on the number of patients who were hospitalized due to COVID-19 [28]. The considerable reduction in the number of hospitalized patients may also explain the significant decrease

in the perceived stress experienced by Portuguese nurses in T1 and T2 compared to T0, as the literature indicates working shifts, long hours, a lack of control, and unfavorable working conditions, which were common during the COVID-19 pandemic, as being some of the significant causes of stress among nurses at work [52–54].

Physical QoL

Among Portuguese nurses, those with lower perceived stress levels, higher resilience, greater social support, and/or elevated job satisfaction generally experienced better physical QoL during the COVID-19 pandemic. Perceived stress was the determinant that most explained a lower physical QoL in Portuguese nurses; additionally, even though we did not find evidence in the literature that directly correlates nurses' perceived stress and physical quality of life, this association may be explained by two reasons: (a) stress itself may manifest as physical symptoms (somatization) [55]; and (b) findings from a previous study that aimed to explore whether sex moderated the relationship between perceived stress and somatization in the general population during the COVID-19 pandemic showed that the relationship between perceived stress and somatization was more robust in females than in males (which is relevant if we consider our sample to be mainly composed of female nurses) [56].

Perceived social support was the second most relevant protective factor for Portuguese nurses' physical quality of life. Indeed, scientists have long observed an association between social support and physical health. More socially isolated or less socially integrated individuals are less physically healthy and more likely to die [57]. There are also some systematic reviews and meta-analyses that have indicated that low social support has an impact on the incidence of coronary heart disease [58]. Thus, it seems clear that social support is a relevant predictor of physical health outcomes [59].

Psychological QoL

Nurses in Portugal who demonstrated lower perceived stress, enhanced resilience, strong social support, and/or increased job satisfaction were more likely to report improved psychological QoL throughout the COVID-19 pandemic. Once again, perceived stress was the factor that most explained Portuguese nurses' psychological QoL. Regarding this association, the literature notes that in a situation of long-term involvement in strenuous work and the emergence of failures in achieving goals (stressful work), such as was experienced throughout the COVID-19 pandemic, the requirements of the environment may exceed the psychological abilities of a human [60, 61], which may correspondingly cause a threat to self-efficacy and lower self-esteem, thus adversely affecting the psychological quality of life [62].

In addition to physical QoL, perceived social support was a significant protective factor against psychological QoL. This finding is in conjunction with previous research indicating that nurses' overall QoL positively correlates with social support [63]. Moreover, research on patients demonstrated a significant positive association between social support and quality of life [64]. However, surprisingly, we found no association between social support from supervisors/colleagues and psychological quality of life. Although this was an expected finding, it tends to be consistent with previously reported evidence. For example, a cross-sectional online survey conducted from the 1st of July to the 21st of July 2020 in Malaysia indicated that greater perceived social support from friends and significant others predicted greater QoL in health care workers [65]. It is relevant to highlight that social support seems appropriate for nurses throughout the COVID-19 pandemic, primarily if close-knit individuals provide it.

Professional well-being

Portuguese nurses who exhibited low perceived stress, high resilience, robust social support from supervisors and colleagues, and/or a strong sense of job satisfaction tended to achieve greater professional well-being amid the challenges of the COVID-19 pandemic. Job satisfaction was the determinant that most explained Portuguese nurses' professional well-being. Although we did not find any study directly related to these two variables in nurses, a survey performed with teachers showed that higher job-related well-being was linked to higher job satisfaction rates [66].

Another relevant determinant was resilience, which had a positive impact on Portuguese nurses' physical and psychological QoL. Thus, resilience seems to play a pivotal role as a protective factor against all of the outcomes of our study, as previous research has indicated that (a) resilience can counter the adverse effects of stressful work-related life events in health care workers [67], thus improving their professional well-being, and (b) it serves as a protective factor for both physical and psychological QoL among nursing faculty during the COVID-19 pandemic [68]. Curiously, there was no association between professional identification and professional well-being. According to the literature, a well-established professional identity in nursing is considered to be essential for maximizing the well-being of nurses [69]. Professional identification was measured using a single-item measure of social identification, which may help explain this unexpected finding; thus, it seems crucial to perform further research on the association between these two variables.

Strengths and limitations

To the best of our knowledge, this is the first study conducted throughout the COVID-19 pandemic to examine how perceived stress, resilience, social support, psychosocial work environment and professional identification influenced nurses' psychological and physical QoL, and professional well-being over time. This is the first study performed in Portuguese individuals with the abovementioned aim. The performance of prospective cohort studies that aim to examine the impact of the COVID-19 pandemic on health care workers, particularly on nurses, seems crucial for distinguishing causes and effects [70] and enhancing the readiness to cope better with future epidemics and/or pandemics.

Despite its strengths, our study also had several limitations. First, the data collection at timepoint 2 was performed between May 2023 and June 2023; additionally, on the 5th of May 2023, the WHO Director-General declared COVID-19 a global health emergency. Thus, most of the data collection at timepoint 2 was conducted after the official end of the COVID-19 pandemic. Moreover, due to our data collection procedure (which involved posting a link to participate in an online self-administered questionnaire on the OE website), it is not possible to guarantee the sample's representativeness. Moreover, the sample was self-selected, which may have introduced selection bias. Nurses with a greater interest in mental health or quality of life, or those with more negative experiences during the pandemic, may have been more likely to participate, potentially influencing the findings, particularly concerning professional well-being and perceived stress.

Additionally, the study did not control for external factors such as changes in healthcare policies, institutional resources, or the implementation of specific well-being support programmes, which could have significantly impacted nurses' well-being but were not accounted for in the analysis. While our findings provide valuable insights into the well-being and quality of life of nurses in Portugal during the pandemic, the generalisability to other contexts or countries may be limited. Different healthcare systems, vaccination rates, and pandemic responses may have resulted in distinct experiences for nurses in other regions.

Furthermore, our reliance on self-reported data introduces the potential for social desirability bias, where participants may have reported responses they believed to be more socially acceptable, particularly regarding their resilience or well-being at work. Finally, our retention rate from timepoint 0 to timepoint 1 was lower than 50%, which can lead to attrition bias. However, sensitive analyses were conducted and the results suggest that our conlusions have not been biased by attrition. Given the face-to-face data collection was impossible throughout the COVID-19 pandemic (mainly at timepoint 0 from November 2021 to January 2022), our study contributes important insights into the evolving well-being of nurses during this critical period.

Conclusions

The findings from our study have significant implications for clinical practice, education, and healthcare management. They underscore the need for targeted interventions to reduce stress, enhance resilience, and foster job satisfaction among nurses. Such interventions could include structured resilience training programmes, regular mental health check-ins, and peer-support systems that allow nurses to share experiences and coping strategies in a safe environment. By doing so, we can improve their QoL, professional well-being, and effectiveness in health care delivery, particularly during high-stress periods such as pandemics.

Incorporating these findings into nursing education is also crucial to better equip nurses to navigate high-stress scenarios. Training programmes should include modules on stress management, self-care strategies, and building emotional resilience to better prepare nurses for the demands of the profession. Simulated crisis scenarios, reflecting the pressures of a pandemic or other volatile situations, could enhance preparedness by providing practical tools to manage stress and workload effectively. Educators should also focus on teaching leadership and communication skills that enable nurses to seek social and supervisor support when necessary.

Health care managers should prioritize supportive work environments by acknowledging the importance of social support, supervisor support, and job satisfaction in maintaining a resilient and satisfactory nursing workforce. This includes providing adequate resources, offering access to counselling services, and ensuring manageable nurse-to-patient ratios to reduce burnout risk. Managers should also prioritise regular team-building activities that strengthen interpersonal relationships and create a collaborative, supportive culture. Acknowledging and addressing the specific stressors nurses face, and providing real-time feedback and recognition, can significantly enhance job satisfaction and professional well-being. Furthermore, the study's longitudinal design provides a unique contribution to the field, offering insights into the dynamic interplay between stressors and protective factors over time. This is particularly relevant in a context like Portugal, where limited longitudinal research has been conducted on nurses' QoL and professional well-being during the COVID-19 pandemic. The application of the Neuman Systems Model as a framework highlights a salutogenic perspective, focusing on health-promoting factors rather than solely on risk

factors, which enriches the theoretical understanding of these phenomena.

Given the global reliance on healthcare systems, there is an urgent need for policymakers, administrators, and educators to implement these evidence-based strategies. Doing so will not only improve nurses' QoL and professional well-being but also strengthen healthcare systems' resilience to future crises. These findings must catalyse immediate action to ensure a sustainable and effective healthcare workforce capable of delivering high-quality care under even the most challenging conditions.

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Conceptualization, R.S., F.S., P.D., I.G., A.O.B. and C.O.B.; data curation, R.S. and J.J.; formal analysis, R.S. and J.J.; investigation, R.S., F.S., P.D., I.G., A.O.B. and C.O.B.; methodology, R.S., F.S., P.D., I.G., A.O.B. and C.O.B.; project administration, C.O.B.; supervision, P.D., I.G., A.O.B. and C.O.B.; validation, P.D. and I.G.; visualization, R.S. and J.J.; writing—original draft, R.S., F.S., and J.J.; writing—review and editing, R.S., F.S., J.J., P.D., I.G., A.O.B. and C.O.B. All of the authors have read and agreed to the published version of the manuscript.

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Data availability
The data presented in this study are available upon request from the corresponding author. The data are not publicly available due to the presence of health information.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki and the Declaration of Oviedo and was approved by the Ethics Committee of the Portuguese Society of Mental Health Nursing (protocol code: 03/MS/2021; date of approval: July 12th, 2021). Informed consent was obtained from all of the participants in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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