


Article

Burnout, Resilience, and COVID-19 among Teachers: Predictive Capacity of an Artificial Neural Network

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Abstract: Emotional exhaustion, cynicism, and work inefficiency are three dimensions that define burnout syndrome among teachers. On another note, resilience can be understood as the ability to adapt to the environment and overcome adverse situations. In addition, COVID-19 has provided a threatening environment that has led to the implementation of resilience strategies to struggle with burnout and cope with the virus. The aim of this study was to analyze the relationship between resilience, burnout dimensions, and variables associated with COVID-19 through the design of an artificial neural network architecture. For this purpose, the Maslach Burnout Inventory-General Survey (MBI-GS), the Brief Resilience Coping Scale (BRCS), and a questionnaire on stress towards COVID-19 were administered to 419 teachers from secondary schools in southeastern Spain (292 females; 69.7%). The results showed that 30.8% suffered from burnout (high emotional exhaustion, high cynicism, and low professional efficacy) and that 38.7% had a high level of resilience, with an inverse relationship between both constructs. Likewise, we modelled an ANN able to predict burnout syndrome among 97.4% of teachers based on its dimensions, resilience, sociodemographic variables, and the stress generated by COVID-19. Our conclusions shed some light on the efficacy of relying on artificial intelligence in the educational field to predict the psychological situation of teachers and take early action.

Keywords: artificial intelligence; artificial neural networks; burnout; COVID-19; resilience; teachers



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1. Introduction

1.1. Burnout Syndrome

Burnout syndrome is a state of stress that affects people at a psychological level, producing changes in attitude, mood, demotivation in terms of work, and others [1]. It seems that exposure to certain levels of stress for a prolonged period of time may play a relevant role in the appearance of the syndrome [2–6]. The term was coined by Freudenberger in 1974 [7] and was popularized, among other studies, by the research of [8,9] who define it as high emotional exhaustion, high depersonalization, and low professional fulfillment. Treated as a disease, the World Health Organization [10] has also defined this construct specifically, considering it a syndrome conceptualized as a result of chronic workplace stress that has not been successfully managed. In fact, it is considered that up to 50% of workers could suffer from emotional exhaustion, one of the dimensions of the syndrome [11]. Likewise, it is considered that a large part of mental illness is, in part, due to factors related to occupational stress, affecting people in all biological, social, and psychological areas [12,13].

Of all the educational stages where the syndrome can emerge, it seems that Compulsory Secondary Education is the one in which burnout symptoms are most evident [4].

The consequences on job performance are evident and can lead to abandonment, previously passing through disinterest and a decrease in the teacher's commitment to his or her task [14,15]. There are several factors that can trigger adverse effects and break the physical and mental balance of individuals, such as rapid social changes, especially when they involve rapid adaptation [16]. The type of work also has an influence [17]. Those professional sectors that require greater emotional and social involvement are the most affected by the changes occurring in society requiring greater responsibility in their professional work [18,19]. For this reason, one of the sectors most affected by the burnout phenomenon is education [20], whose professionals are subjected to constant changes in the curriculum, overwork, loss of professional recognition, scarce autonomy to develop their functions, among other factors [5,21–24]. As a consequence, the teaching role is immersed in the ideal conditions to develop the syndrome [25,26].

The way in which emotions are managed will be related to a higher probability of occurrence of the syndrome [27]. The interactions between teachers and students should also be highlighted as they are an essential part of daily teaching work [22]. At this point it should be considered that not only do teachers have to perform their work within the classroom effectively, but they also have to face problematic situations, disruptive behaviors, and emotional conflicts with their students, becoming key and vitally important factors in the occurrence of burnout [28]. Therefore, the appearance of the syndrome depends not only on work factors but also on personal elements such as the social skills and coping strategies of the teacher so that the symptoms are, to some extent, idiosyncratic [29].

1.2. Resilience

Resilience, defined at the end of the 20th century [30,31], can be considered a strategy put in place to cope with stressful situations [24,32–34]. It is the ability to be able to adapt to adverse situations [15,35–37]. Aspects such as people's positive emotions (happiness, optimism, self-esteem, and assertiveness that the individual possesses) will be fundamental in the face of these problematic situations [38,39]. Therefore, the term resilience is linked to protective factors that people develop throughout their development. In other words, this construct is not a concept that is inherited and passed from one generation to another but is a term that is acquired and developed throughout life and through adverse experiences and the control of emotions that individuals have over themselves [40,41].

It is important to underline the importance of resilience in teachers, since teachers who suffer the ravages of stress tend to be professionals with lower job performance and worsened teaching ability and, consequently, students' academic achievement suffers [36]. It has also been observed that those teachers who possessed stronger thoughts and emotions were able to cope with situations that required firm temperance and thus reduce the effects of stress that could cause them [36]. It is the responsibility of the educational system to develop such strategies and introduce resilience in teacher training plans as it results in better qualified people [15,42–44]. An example is the SmartInEducation methodology aimed at developing resilience and stress management techniques [45]. Of course, this social objective entails difficulties, such as developing adequate resources to foster these strategies among teachers and their inclusion in training programs [46,47]. Despite all the adverse variables that this group faces on a daily basis, it seems that it shows average levels of resilience in general terms [48,49].

1.3. Burnout and Resilience

Regarding the relationship between burnout syndrome and resilience, at the international level the research carried out by Salmela-Aro et al. (2019) [25] demonstrates the importance of investigating the effects that burnout syndrome produces in teachers and the importance of resilience as a strategy to cope with its symptoms. In the same order of ideas and direction, Trigueros et al. (2020) [41] emphasized the importance of resilience in coping with and predicting burnout levels, as well as the relevance of the mental and physical well-being of teachers in order to develop a good work practice. Those teachers

who have few resilient strategies are more vulnerable to the effects that stress can produce and to the extent of burnout syndrome, while those who have high resilient capacities are able to develop personal resources that allow them to cushion the impacts produced by their work environment [50], although sociodemographic variables such as gender can vary the results [51]. It has also been found that those teachers with more experience tend to have greater resilience to better manage stress and to have internalized the strategies against the syndrome, although these results vary with the educational stage. In particular, research developed at the secondary school stage shows that teachers with a higher level of demand in their work environment do not always manage to have adequate resilience capacity and are more likely to suffer stress compared to other educational stages [50]. In general terms, it seems that people with high resilience are less likely to suffer burnout syndrome [52], and that this reduces the possibility of suffering psychological problems and psychiatric disorders [53].

1.4. COVID-19 and Artificial Intelligence

In addition, the worldwide COVID-19 pandemic has provoked a paradigm shift in the different educational systems around the world and has required the educational community to make an enormous effort to adapt to a new and threatening situation [54,55]. This scenario has resulted in teachers having to implement a series of strategies to combat stress [56]. It is estimated that as the environmental conditions have changed, the responses that can be given to the questionnaires, in particular, and to the environment in general, have been modified and that there are also individual differences [57–59].

Despite the studies generated, the information gathered by the scientific community is not sufficient and further research is needed [4]. After the eruption of COVID-19, teachers had to make changes in their coping strategies to cope with the demands of the environment [56]. For this reason, it is necessary to continue researching burnout syndrome and its interaction with resilience in this new scenario replete in which other variables come into play, such as the fear of contagion from family, friends and co-workers, to cite a few examples.

Within the framework of current research, artificial intelligence is proving to be an effective tool for predicting with great precision the possibility of an event occurring [60]. The large amount of data to be managed nowadays in a complex society makes necessary a methodology that allows analyzing the impact of COVID-19 on the educational system and the members that compose it [56]. Within artificial intelligence, artificial neural networks allow the development of models with a high predictive capacity and autonomous learning capacity [61], an ideal tool for studying the relationship between variables such as resilience and other psychoeducational factors [62].

1.5. Objectives and Hypotheses

The general objective of the present study was to evaluate and interpret the levels in the dimensions of burnout, resilience, and other variables associated with the perception of stress towards COVID-19 that secondary school teachers in the Region of Murcia possess, as well as to study the relationship between these constructs, designing an artificial neural network with predictive capacity to evaluate burnout syndrome.

Based on this general objective, the specific objectives of our research were to: (1) evaluate the level of burnout presented by the Compulsory Secondary Education teachers of the Region of Murcia who participated in the study; (2) examine the levels of resilience possessed by the teachers participating in the research; (3) establish the possible relationships between the constructs of burnout and resilience; (4) analyze the existence of possible statistical significance between the levels of burnout and variables associated with COVID-19; (5) study the existence of possible statistical significance between the levels of resilience and variables associated with COVID-19; and (6) design an artificial neural network that uses the dependent variable of burnout (presence versus absence of

the syndrome) as an output layer to analyze the contribution of the independent variables to the predictive capacity of the network.

Likewise, the following hypotheses were formulated:

Hypothesis (H1). *Moderate levels of burnout were expected to be found in secondary school teachers;*

Hypothesis (H2). *Resilience levels in secondary school teachers were expected to be medium;*

Hypothesis (H3). *An inversely proportional relationship was expected to be found between burnout and resilience dimensions;*

Hypothesis (H4). *Higher levels of burnout were expected to be found in those teachers who had experienced variables associated with COVID-19;*

Hypothesis (H5). *Lower levels of resilience were expected to be found in teachers who had experienced variables associated with COVID-19.*

2. Materials and Methods

2.1. Design and Procedure

The research design was quantitative, cross-sectional, and ex post facto. With respect to the procedure, in January and February 2021 we visited the educational centers in order to request permission from the management teams and to collect the sample necessary to carry out the present study. A formal letter of presentation was made to justify the reason for carrying out this work. The participation of the teachers of Compulsory Secondary Education was anonymous and voluntary, and the treatment of the data was anonymous, following the ethical guidelines of the Helsinki Protocol and the Ethical Committee of the University of Murcia. Due to the current pandemic that is being experienced worldwide, the decision was made to carry out the aforementioned questionnaires through an online platform, unifying them in a single document and in a telematic manner so as not to put the population of this study at risk.

2.2. Participants

The general population selected for the present study consisted of 8278 teachers of Compulsory Secondary Education in the public sector in the Region of Murcia, Spain. Once the sample was selected, the participation of a group of 419 subjects was achieved, which meant a participation of 5.06% of the teaching staff. This is a significant sample of the teaching sector given that the minimum sample size based on the chosen population was 368, a figure calculated using the sample calculators, with a margin of error of 5% and a confidence level of 95%. The Cohen's effect size was $d = 0.8$. The response of the female gender was higher than that of the male gender, since 292 people who participated in the study were women, that is, 69.7% of the total sample. Thus, the participation of the male gender constituted 30.3% of the total sample, equivalent to 127 male participants. The mean age of the participants was 44.37 ($SD = 9.385$). The mean teaching experience was 15.33 ($SD = 10.059$). Regarding marital status, 50.8% (213) were married, 21% (88) were cohabiting, 19.1% (80) were single, 7.9% (33) were divorced, and 1.2% (5) were widowed.

2.3. Instruments

The following questionnaires were used:

Stress Evaluation Questionnaire for COVID-19 (SEQ-COVID-19). An ad hoc instrument designed by the authors of the present study that included items on the stress situation in the face of COVID-19 as well as various sociodemographic variables aimed at the participating teachers (gender, age, years of experience, marital status, and whether they had offspring) (Appendix A). The items focused on COVID-19 collected information about the level of stress generated by: (1) being infected by COVID-19; (2) a family member

being infected; (3) a co-worker being infected; (4) a student being infected; (5) the student's family being infected; and (6) friends being infected. A Likert-type scale ranging from 1 "does not stress me at all" to 10 "stresses me a lot" was used. The sum of the six items resulted in a variable called "COVID-19 Stress". This is used as a variable in the ANN.

Maslach Burnout Inventory-General Survey. Spanish adaptation by [63] of the Maslach Burnout Inventory-General Survey (MBI-GS), based on the MBI by [8,9] and on the burnout construct defined by [64], according to which individuals who are subjected to continuous levels of stress at both personal and relational levels in the workplace may develop three dimensions: high burnout, high cynicism, and low professional efficacy. The MBI-GS is composed of 15 items divided as follows: items 1, 2, 3, 4, and 6 belong to the burnout dimension (example item: "I am emotionally exhausted by my job"), items 5, 7, 10, 11, 12, and 15 to the professional efficacy dimension (example item: "I can effectively solve problems that arise in my job") and, finally, items 8, 9, 13, and 14 to the cynicism dimension (example item: "I have lost interest in my job since I started in this position"). It should be added that each item in the questionnaire comes with a letter at the end of it, referring to the dimension to which it belongs. In addition, the items of which this questionnaire is composed must be answered through a Likert-type scale with the lowest score (0) being never/never and the highest score (6) always/every day. This questionnaire is reliable and valid. In the research carried out by [9], the 22-item instrument had a Cronbach's alpha of 0.9 for the emotional exhaustion dimension, 0.79 for the cynicism dimension, 0.71 for professional efficacy and, finally, an overall alpha of the three dimensions of 0.76. In global terms, the Cronbach's alpha obtained in this research was 0.8.

Brief Resilience Coping Scale (BRCS). Instrument developed by [65] and adapted to Spanish by [66]. It consists of 4 items on a Likert-type scale from 1 to 5, where 1 means that it does not reflect a typical reaction at all and 5 reflects the usual way of responding. An example of a questionnaire item is "I look for creative ways to cope with difficult situations". Scores range from 4 to 20. According to the authors, a score of 13 points or less indicates low resilience. If the score obtained is equal to or higher than 17, it is said to be high resilience. It is a reliable and valid instrument. It has a Cronbach's alpha of 0.86. In the present investigation a Cronbach's alpha of 0.73 was obtained.

2.4. Data Analysis

The data collected were analyzed with the SPSS version 24 statistical program. A descriptive analysis was performed through which the main dispersion indexes, as well as frequencies and percentages, were analyzed. An inferential analysis was also performed to evaluate the relationship between variables, assuming a significance of at least 0.5. For the design of the artificial neural network (ANN), a multilayer perceptron network with a backpropagation algorithm was used. The dependent variable was "Burnout (presence versus absence)", of a nominal nature (presence of burnout = 0 and absence of burnout = 1). The order in which the variables were introduced into the system was as shown in the following lines. Any change in the order modifies the predictive capacity of the network. Three nominal factors were selected: gender, marital status, and children. Of a quantitative nature, the seven covariates used were: age, experience, burnout, cynicism, efficiency, resilience, and COVID-19 stress. The scale change of the covariates was normalized. Regarding the partitioning of the total cases, the network was instructed to use 60% for the training phase, 20% to perform the test phase, and 20% for the reserve phase, although the network itself adjusted the percentage during its setup through a random assignment procedure. Thus, finally 64.4% (270) of the cases were assigned to the training phase, 17.4% (73) were assigned to the testing phase, and 18.1% (76) to the holdout phase.

3. Results

3.1. Analysis of the Presence of Burnout Syndrome and Resilience Level

Regarding burnout syndrome, 30.8% (120) of the participants were found to suffer from burnout syndrome (high burnout, high cynicism, and low efficacy). Regarding

resilience levels, it was found that 38.7% (162) of the faculty had high resilience, 41.1% (172) had medium resilience, and 20.3% (85) had low resilience.

3.2. Correlation between the Dimensions of Burnout and Resilience

Pearson’s correlation analysis showed that the burnout dimension had a direct and significant correlation with cynicism ($r = 0.521, p < 0.001$) and a negative correlation with resilience ($r = -0.228, p < 0.01$). With respect to the cynicism dimension, a statistically significant and inverse correlation was found with burnout ($r = -0.392, p < 0.001$) and with resilience ($r = -0.357, p < 0.01$). In relation to the efficacy dimension, a significant and direct correlation was found with resilience ($r = 0.489, p < 0.001$).

3.3. Correlation between Burnout Dimensions and Variables Associated with COVID-19

The correlation between the presence or absence of stress associated with the different forms of contagion of the virus (family, direct contagion, coworkers, students, student’s family, and friends) and its correlation with the dimensions of burnout syndrome are shown in Table 1.

Table 1. Descriptive statistics and significance of Student’s *t*-test for burnout dimensions and stress associated with COVID-19.

		N	M	SD	Mean Standard Error	p-Value
Family contagion						
Exhaustion	Absence	36	2.15	1.296	0.216	0.000
	Presence	383	3.12	1.632	0.083	
Cynicism	Absence	36	1.35	0.977	0.163	0.005
	Presence	383	1.88	1.480	0.076	
Efficiency	Absence	36	4.58	0.835	0.139	0.963
	Presence	383	4.58	0.759	0.039	
Direct transmission of the virus						
Exhaustion	Absence	127	2.37	1.46	0.13	0.000
	Presence	292	3.33	1.61	0.09	
Cynicism	Absence	127	1.61	1.41	0.13	0.038
	Presence	292	1.93	1.46	0.09	
Efficiency	Absence	127	4.57	0.78	0.07	0.777
	Presence	292	4.59	0.76	0.05	
Contagion of coworkers						
Exhaustion	Absence	172	2.45	1.49	0.11	0.000
	Presence	247	3.45	1.60	0.1	
Cynicism	Absence	172	1.71	1.46	0.11	0.154
	Presence	247	1.91	1.44	0.09	
Efficiency	Absence	172	4.52	0.76	0.06	0.136
	Presence	247	4.63	0.76	0.05	
Contagion of the students						
Exhaustion	Absence	131	2.37	1.472	0.13	0.000
	Presence	288	3.34	1.606	0.1	
Cynicism	Absence	131	1.66	1.454	0.13	0.098
	Presence	288	1.91	1.444	0.09	
Efficiency	Absence	131	4.53	0.784	0.07	0.299
	Presence	288	4.61	0.756	0.05	
Contagion of the students’ families						
Exhaustion	Absence	187	2.45	1.45	0, 11	0.000
	Presence	232	3.51	1.61	0, 11	
Cynicism	Absence	187	1.67	1.40	0, 10	0.038
	Presence	232	1.96	1.48	0, 10	
Efficiency	Absence	187	4.55	0.76	0.06	0.362
	Presence	232	4.61	0.77	0.05	
Contagion of friends						
Exhaustion	Absence	87	2.3	0.44	0.15	0.000
	Presence	332	3.23	1.62	0.09	
Cynicism	Absence	87	1.63	1.28	0.14	0.146
	Presence	332	1.88	1, 49	0.08	
Efficiency	Absence	87	4.43	0.76	0.08	0.041
	Presence	332	4.62	0.76	0.04	

Note: N: participants; M: mean; SD: standard deviation; p-value: bilateral significance in Student’s *t*-test.

3.4. Correlation between Resilience and Variables Associated with COVID-19

Table 2 shows the mean scores obtained by the teachers in the resilience variable according to the presence or absence of perceived stress in the face of COVID-19 infection and the significance (bilateral) of Student’s *t*-test.

Table 2. Descriptive statistics and significance of Student's *t*-test for resilience and stress associated with COVID-19.

		<i>N</i>	<i>M</i>	<i>SD</i>	Standard. Error Mean	<i>p</i> -Value
Family stress						
Resilience	Absence	36	16.53	2.94	0.49	0.047
	Presence	383	15.57	2.75	0.14	
Virus stress						
Resilience	Absence	127	16.13	2.87	0.26	0.019
	Presence	292	15.44	2.71	0.16	
Stress from colleagues						
Resilience	Absence	172	15.71	2.85	0.22	0.098
	Presence	247	15.61	2.73	0.17	
Student stress						
Resilience	Absence	131	15.76	2.98	0.26	0.579
	Presence	288	15.6	2.68	0.16	
Stress about your students' families						
Resilience	Absence	187	15.78	2.87	0.21	0.393
	Presence	232	15.55	2.7	0.18	
Stress for friends						
Resilience	Absence	87	15.69	2.87	0.31	0.886
	Presence	332	15.64	2.75	0.15	

Note: *N*: participants; *M*: mean; *SD*: standard deviation; *p*-value: bilateral significance in Student's *t*-test.

3.5. Artificial Neural Network Design and Architecture

An ANN was designed consisting of an input layer, a hidden layer (consisting of seven units and the hyperbolic tangent activation function), and an output layer (consisting of two units, a softmax activation function, and the cross-entropy function error). The statistical program itself generated the number of neurons in the hidden layer, by trying to develop the minimum possible number of neurons or nodes to optimize the network. Figure 1 shows the connectivity between nodes arranged in three layers.

In the training phase, the cross-entropy error was 48.215 and the percentage of incorrect predictions was 7%. The learning rule stopped after one consecutive step without reduction of the error rate. The type of training was batch and with an optimization algorithm based on the scaled conjugate gradient. The initial lambda value for training was 0.0000005, the initial sigma value was 0.00005, and the interval offset was ± 0.5 . Regarding the testing phase, the cross-entropy error was 10.190 and the percentage of incorrect predictions was 6.8%. Finally, in the holdout phase, the percentage of incorrect predictions was reduced to 2.6%.

Table 3 shows the contribution of each of the factors and covariates (independent variables) to the dependent variable of the network through the importance indexes (scale from 0 to 1) and normalized importance (scale from 0 to 100%).

Table 3. Importance of independent variables in the artificial neural network.

	Importance	Normalized Importance
Genre	0.024	4.6%
Civil status	0.081	15.5%
Children	0.026	5%
Age	0.076	14.6%
Experience	0.049	9.4%
Exhaustion	0.054	10.4%
Cynicism	0.083	15.9%
Efficiency	0.522	100%
Resilience	0.053	10.2%
COVID-19 stress	0.032	6.1%

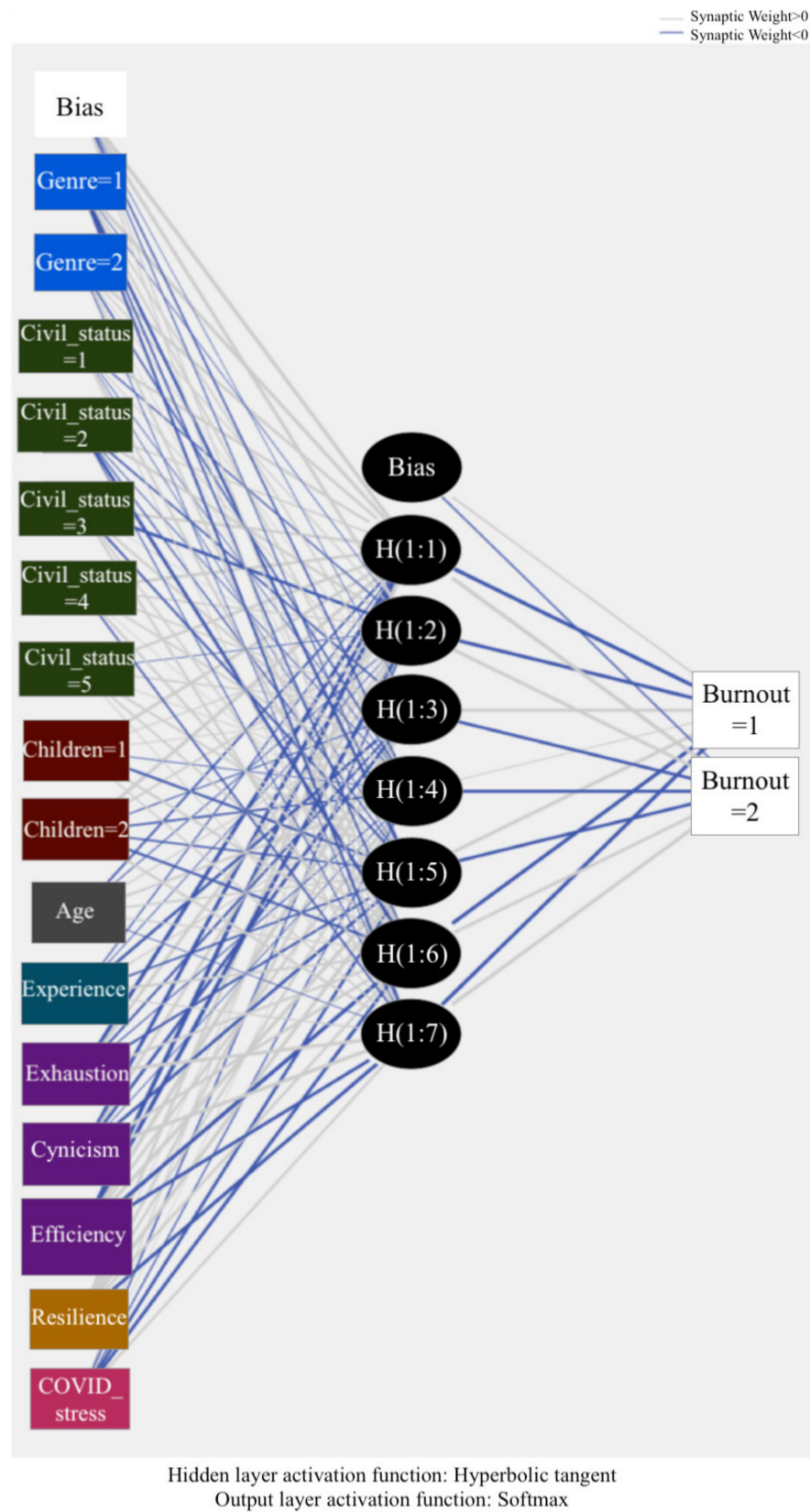


Figure 1. Artificial neural network with predictive capacity for the dependent variable burnout syndrome. Note. Genre = 1: Female; Genre = 2: Male; Civil_status = 1: Single; Civil_status = 2: With partner; Civil_status = 3: Married; Civil_status = 4: Divorced; Civil_status = 5: Widowed; Children = 1: Yes; Children = 2: No; Burnout = 0: Absence of burnout; Burnout = 1: Presence of burnout.

The predictive capacity of the model is shown in Table 4. A correct prediction percentage of 93% was observed in the sample used for the training phase, 93.2% in the testing sample, and 97.4% in the holdout sample. During the training phase, the model generated a predictive algorithm that was refined and perfected in the testing phase. Finally, in the holdout phase, the neural network used a previously unused sample to test the predictive efficiency, obtaining even higher results. Our data confirm that our neural network was able to self-learn and self-improve. During the testing phase, the network improved its predictive capacity and once the final algorithm was generated, it was used to correctly classify 97.4% of the participants.

Table 4. Predictive capability of the artificial neural network.

Sample	Observed	Predicted		
		Absence of Burnout	Presence of Burnout	Percent Correct
Training	Absence of burnout	176	12	0.94
	Presence of burnout	7	75	0.92
	Overall Percent	0.68	0.32	0.93
Testing	Absence of burnout	43	1	0.98
	Presence of burnout	4	25	0.86
	Overall Percent	0.64	0.36	0.93
Holdout	Absence of burnout	56	2	0.97
	Presence of burnout	0	18	1
	Overall Percent	0.74	0.26	0.97

Note. Dependent Variable: burnout (presence versus absence).

To evaluate ANN performance, ROC curves were used. The area under the curve was 0.983 for both the presence and absence of burnout. This is consistent with the high predictive ability found. The closer the area is to 1, the better the fit of the model to reality. These curves measure the productive capacity of the network or of discriminating cases. Therefore, they are an instrument to assess performance. To evaluate the network by visual analysis, Figures 2–4 are shown. Figure 2 analyzed the relationship between sensitivity and specificity. The diagonal line represents the probability of getting it right in a 50% chance scenario. It can be seen how in the case of both the presence of burnout and in the curve representing the absence of burnout, the lines are to the left of the diagonal, far away from it. These results reflect a high sensitivity of the artificial neural network, detached from mere chance. It can be seen how there are two curves in Figure 2, so that for each of them the specificity and, therefore, the discrimination and sensibility capacity of the network is being shown, becoming practically similar in cases of both presence and absence of burnout. Figure 3 represents the gain with the lines above the diagonal as they are. The graph is a representation of a cumulative gain, and the diagonal is the baseline so that the cases above it represent the cases placed in their category for each situation (presence versus absence). For example, the top 20% of cases contains 60% of the cases with presence of burnout. Finally, Figure 4 refers to the lift. It is possible to observe how the presence and absence of burnout converge to values close to 100%. This figure comes from accumulated earnings and allows us to see the same data in a different perspective.

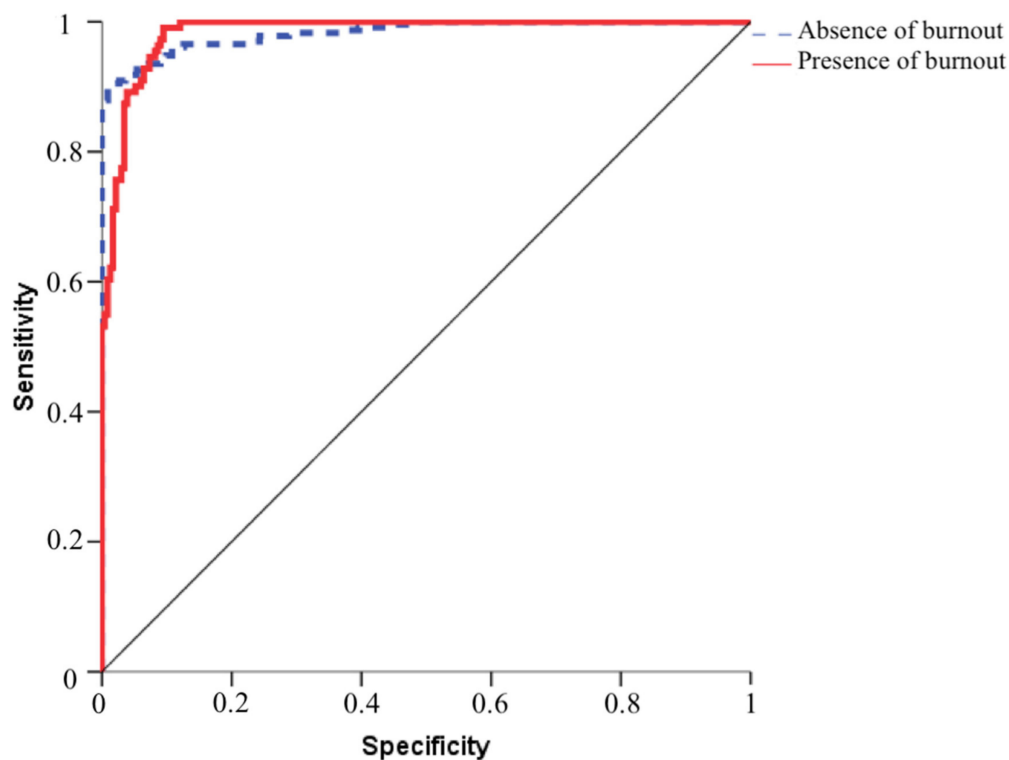


Figure 2. Sensitivity of the artificial neural network.

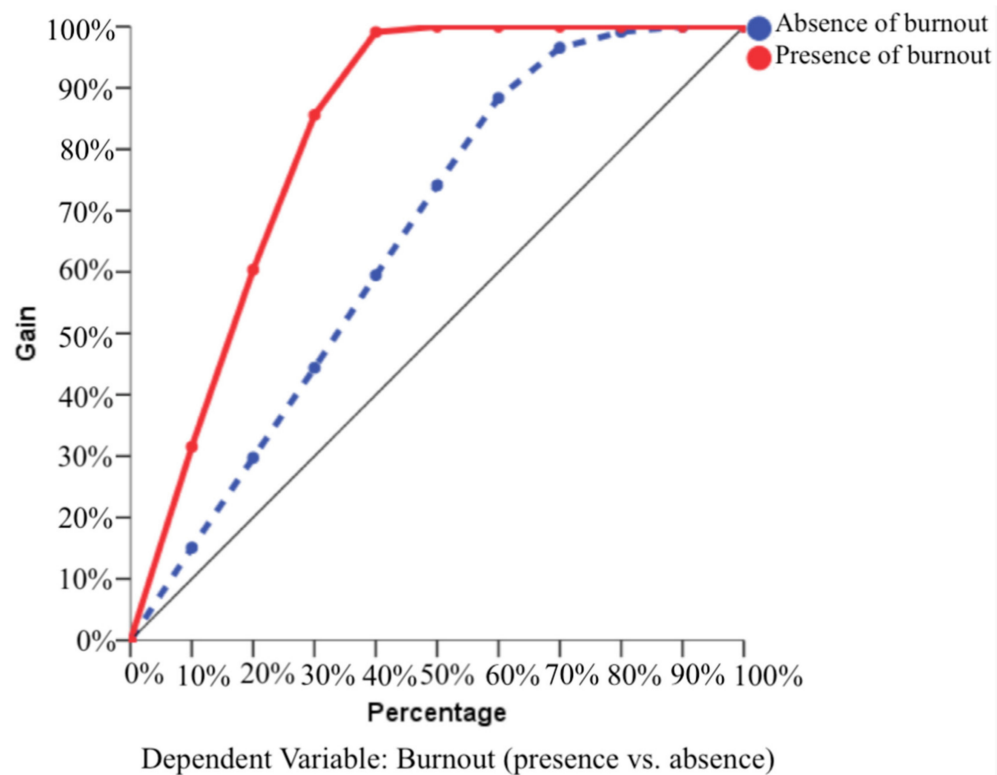


Figure 3. Gain of the artificial neural network.

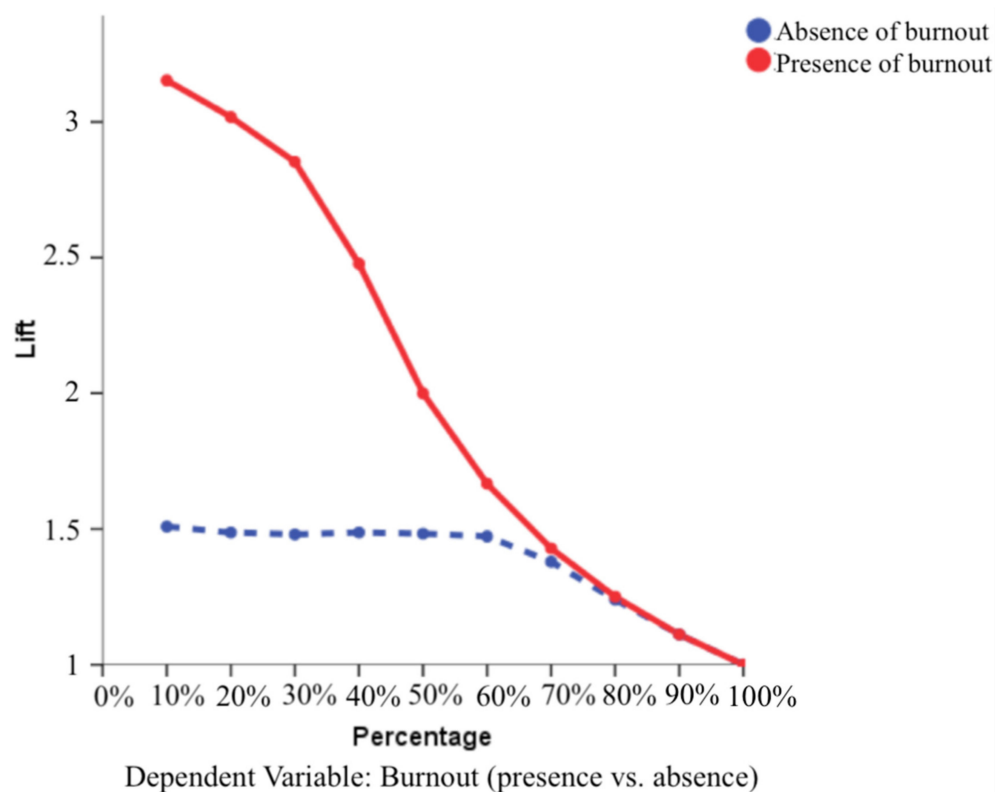


Figure 4. Artificial neural network lift.

4. Discussion

The aim of this study was to evaluate and interpret the levels of burnout and resilience showed by teachers of Compulsory Secondary Education in the Region of Murcia (Spain) in times of COVID-19, by designing an artificial neural network with the capacity to predict the presence or absence of burnout syndrome in this professional group, and by simulating a binary biological neural network where 0 is equivalent to a deactivated node and 1 to an activated node. The response rate obtained in this study reflected the interest of secondary school teachers in burnout in times of pandemic. This experience could be the reason for the appearance of a high percentage of teachers suffering from this syndrome in contrast to what was obtained in previous studies [67].

Our sample data allow us to establish a very varied group by forming an analysis of the constructs that encompass the entire teaching population. In the same line, the participation of women was higher than that of men, as well as that of teachers in a sentimental situation of being in a couple or married. This aspect is of vital importance since there are numerous studies that show that single, widowed, or divorced teachers tend to be more affected by burnout syndrome. This is due to the fact that people who are in a couple or married are more likely to receive support [68,69]. Analyzing the artificial neural network of the present study, it was observed that the variable of marital status contributed 15.5% to the presence or absence of burnout syndrome.

At this stage, it is necessary to respond to the hypotheses that were initially raised in this study. Thus, H1, “if moderate levels of burnout were expected to be found”, is confirmed. It was observed that a medium-high percentage of the participant population suffered from this syndrome, presenting a high level in the emotional exhaustion and cynicism dimensions versus a low level for the professional efficacy dimension. In this sense, taking into account that requirements were met to confirm the presence of burnout syndrome, i.e., that the burnout and cynicism dimensions were high and professional efficacy was low, authors such as [70] showed that, on the burnout scale, the teaching staff obtained a moderate level for this syndrome. Likewise, studies by [13] observed that, of the

participants in their sample, a medium percentage of the population suffered from burnout syndrome, in line with the hypothesis proposed here. With respect to the ANN designed, it was able to correctly locate 97.4% of the cases, differentiating between those who suffered from burnout syndrome and those who did not. The use of this type of network to predict psychoeducational variables and even stress has recently been successfully applied in the university setting [56].

Following the same line of argument, H2 posed in this study, regarding whether “teacher resilience levels were expected to be medium”, has been confirmed. Specifically, in the present study, resilience levels were medium-high. The findings found here can be compared with the studies conducted in Chile by [48] that show that the faculty had resilient skills, in agreement with other authors such as [71] who had undertaken similar research with faculty in Mexico. In the same vein, other research carried out in Peru showed that most of the teachers who participated in the research had a medium level of resilience [49]. Likewise, in Spain it was observed that teachers also have sufficient resilience to cope with adverse situations [24].

For H3, according to which “it was expected to find an inversely proportional relationship between the dimensions of burnout and resilience”, it has been verified. The studies carried out in this research show that there is a low negative correlation between the dimensions of emotional exhaustion and cynicism with resilience, indicating that teachers who are immersed in burnout syndrome are indeed resilient people to some extent. Research carried out by [72] indicated that resilience was indeed a protective effect against this syndrome. Resilience has also contributed to explain the results found in the ANN, reaching 10.2% in terms of its normalized importance.

In response to H4, according to which “it was expected to find higher levels of burnout in teachers who have experienced variables associated with the COVID-19”, the present research has shown that, depending on the dimension of burnout, there may or may not be significant differences. Therefore, h4 is only partially confirmed. It should be noted that in all stress variables against the COVID-19 and the emotional exhaustion dimensions, significant differences were observed in each of them. Due to the lack of documentation we resorted to studies of other educational stages as was the case of research by Morales et al. (2021) [56], who found differences. As for the ANN, stress versus COVID-19 accounted for 6.1% of the normalized significance as an independent variable. It appears that resilience, marital status, and age contribute more to explain the predictive ability of the network than stress caused by fear of contagion. The same was true for gender, which achieved 4.6%.

Finally, in relation to H5, according to which “it was expected to find lower levels of resilience in teachers who had experienced variables associated with COVID-19”, it can be determined that, as in the previous one, it is partially fulfilled since the results fluctuated depending on the source of stress associated with the virus. It is worth noting that significant differences were found between the levels of resilience and the presence or absence of stress associated with their families being infected by COVID-19. The novelty of the study of this association has made it difficult to compare the results with previous research.

Applicability, Limitations, and Future Lines of Research

With respect to the applicability of the study, the analysis carried out throughout this research has made it possible to determine the levels of burnout among secondary school teachers in the Region of Murcia. These data are of interest for subsequent comparative studies between different educational stages and between autonomous communities. It also serves to make visible a reality on which it is necessary to intervene, through the design of intervention programs adjusted to the facts, along the lines previously mentioned [15]. The introduction of artificial neural networks in the field of education represents a field that has hardly been exploited and that has great potential for detecting the syndrome from its initial stages. Knowing which variables contribute most to the presence or absence of the syndrome will allow the design of actions focused on preventing the appearance of

such factors. In fact, our ANN was able to predict and classify 97.4% of the experimental cases. Therefore, the introduction of this kind of algorithm within educational psychology studies should be taken into account. Without a shadow of doubt, artificial intelligence has relevant potential [60].

Regarding the limitations of this study, on the one hand, focusing the research on secondary schools makes it difficult to generalize the results to other educational stages. Likewise, the fact of applying the research questionnaires for data collection at a specific time during the pandemic has meant that it is not possible to see the changes that may occur with respect to burnout syndrome and resilience as one moves towards a normalized situation. On the other hand, in the data analysis, it should be noted that certain aspects of importance are left out, such as, for example, the influence of age on burnout syndrome, teaching experience, and the correlation between resilience and the appearance of the syndrome, among others. Furthermore, difficulties have been encountered in contrasting COVID-19 variables with burnout syndrome and resilience due to the lack of studies and research in this area. In spite of these limitations, this research has been carried out successfully and has had a high percentage of participation. Likewise, it allows us to make visible a real problem in the teaching staff, such as burnout syndrome. It is necessary to pay more attention to the psychological well-being of teachers because it is a group with worrying levels of emotional exhaustion, cynicism, and low job satisfaction.

As for future lines of research, we highlight the need to continue investigating burnout syndrome and resilience in Compulsory Secondary Education teachers during and after the current pandemic, as well as to check how they may be affected by different situations and how these two constructs influence their teaching work and, therefore, the teaching–learning processes of students. Likewise, it would be possible to analyze burnout syndrome and resilience by department in the secondary school stage and observe which of them may be more affected by burnout, as well as which departments have a resilient teaching staff. Another possibility to consider would be to carry out this research at a national level to determine the levels of burnout and resilience of Spanish teachers, opening up the possibility of comparing the results and determining what factors influence each community and even each educational stage (infant, primary, and secondary). In addition, as has been seen throughout this work, it is recommended that the methodology of artificial neural networks be introduced in subsequent studies. This entails using other types of ANN configurations, such as modifying the number of nodes in the output layer or using another algorithm. This entails using other types of ANN configurations, such as modifying the number of nodes in the output layer or using another algorithm.

5. Conclusions

When analyzing the burnout levels of secondary education teachers in the Region of Murcia, a mean of adequate responses was obtained. It was found that 129 teachers (30.8%) presented burnout syndrome, that is, a high rate of exhaustion and cynicism as well as low efficacy. It was also found that 162 teachers (38.7%) showed high resilience, 172 teachers (41.1%) showed medium resilience, and only 85 people (20.3%) showed low resilience, thus making them resilient in the face of the various difficulties they encounter throughout their professional career. When establishing possible correlations between the constructs of burnout and resilience, it was concluded that as one increases, the other decreases, i.e., the greater the burnout syndrome, the less resilience and vice versa. It should be noted that resilience can be understood as the set of skills that people have to cope with adverse situations, depending on multiple factors for its development. Thus, subjects with medium-low resilience are more likely to suffer from this syndrome as they do not possess sufficient resilient skills. The results obtained for the COVID-19 variables and burnout syndrome allow us to conclude that, depending on the burnout dimension, significant differences can be found. In this case, the emotional exhaustion dimension was affected in all COVID-19 cases, obtaining significant differences in each of these variables. However, in the cynicism dimension, significant differences were only found with the

COVID-19 variable related to the stress of being infected with the virus. With respect to the professional efficacy dimension, significant differences were found with two COVID-19 variables (stress caused by the fact that the students' families could be infected and stress caused by the fact that their friends could be infected). The rest were not significant. Finally, the resilience data with the COVID-19 variables showed that there were significant differences between resilience and the COVID-19 variables related to the stress of being infected by your family and the stress of being infected by the virus.

With respect to the ANN design, it was concluded that the variable that most contributed to the explanation of burnout syndrome was professional efficacy, followed by cynicism, marital status, and age. The ANN achieved a high predictive capacity, reaching a probability of 97.4% when classifying cases that the network had not previously analyzed.

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Appendix A. Stress Evaluation Questionnaire for COVID-19 (SEQ-COVID-19)

This instrument is aimed at assessing the stress generated by some variables related to COVID-19 among teachers and professors. Sociodemographic items will appear first, followed by specific items related to the virus. There are no good or bad answers.

CODE (if necessary): _____

Age: _____

Marital status: _____

Years of experience: _____

Children (yes or no): _____

Profession: _____

Please, using a scale from 1 to 10 where "1" means "does not stress me at all" and "10" means "stresses me at a lot".

Regarding COVID-19 (and later), What Is the Level of Stress You Are under Thinking That: (1–10)

1. You become infected with the virus.
2. A member of your family becomes infected with the virus.
3. A friend becomes infected with the virus.
4. A student becomes infected with the virus.
5. A co-worker becomes infected with the virus.
6. A student's family becomes infected with the virus.

Thank you very much for your cooperation.

References

1. Góngora, F.; Pérez, M.L.; Torres, M.R. Síndrome de burnout y enfermería: Diagnóstico y prevención. In *Gestión Pública de la Salud*; Jiménez, F.R., López, F.J., Eds.; Asociación Cultural y Científica Iberoamericana: Madrid, Spain, 2016; pp. 121–126.
2. Chesak, S.S.; Khalsa, T.K.; Bhagra, A.; Jenkins, S.M.; Bauer, B.A.; Sood, A. Stress Management and Resiliency Training for public school teachers and staff: A novel intervention to enhance resilience and positively impact student interactions. *Complement. Ther. Clin. Pr.* **2019**, *37*, 32–38. [CrossRef]
3. Gallardo-López, J.; López-Noguera, F.; Gallardo-Vázquez, P. Analysis of burnout syndrome in teachers of preschool, middle school and high school for prevention and treatment. *Rev. Electr. Educare* **2019**, *23*, 1–20. [CrossRef]
4. Pinel, C.; Pérez, M.; Carrión, J. Investigación sobre el burnout en docentes españoles: Una revisión sobre factores asociados e instrumentos de evaluación. *Bordón. Rev. Pedag.* **2019**, *71*, 115–131. [CrossRef]
5. Rodríguez-García, A.M.; Sola-Martínez, T.; Fernández-Cruz, M. Impacto del Burnout en el desarrollo profesional del profesorado universitario. Una revisión de la investigación. *Rev. Electr. Interuniv. Form. Prof.* **2017**, *20*, 161–178. [CrossRef]
6. Teles, R.; Valle, A.; Rodríguez, S.; Piñeiro, I.; Regueiro, B. Perceived stress and indicators of burnout in teachers at portuguese higher education institutions (HEI). *Int. J. Environ. Res. Public Health* **2020**, *17*, 3248. [CrossRef] [PubMed]
7. Freudenberger, H.J. Staff burnout. *J. Soc. Issues* **1974**, *30*, 159–165. [CrossRef]
8. Maslach, C.; Jackson, S.E. The measurement of experienced burnout. *J. Organ. Behav.* **1981**, *2*, 99–113. [CrossRef]
9. Maslach, C.; Jackson, S.E. *Maslach Burnout Inventory*, 2nd ed.; Consulting Psychologists Press: Palo Alto, CA, USA, 1986.
10. World Health Organization. *Proceedings of the International Statistical Classification of Diseases and Related Health Problems*, 11th ed.; WHO: Geneva, Switzerland, 2018. Available online: <https://icd.who.int/browse11/1-m/en> (accessed on 10 July 2021).
11. Bitran, M.; Zuñiga, D.; Pedrals, N.; Echeverría, G.; Vergara, C.; Rigotti, A.; Puschel, K. Burnout en la formación de profesionales de la salud en Chile: Factores de protección y riesgo, y propuestas de abordaje desde la perspectiva de los educadores. *Rev. Med. Chile* **2019**, *147*, 510–517. [CrossRef]
12. Bustamante, E.; Bustamante, F.; González, G.; Bustamante, L. El burnout en la profesión docente: Un estudio en la escuela de bioanálisis de la Universidad de Carabobo Sede Aragua, Venezuela. *Med. Secur. Trab.* **2016**, *62*, 111–121.
13. Esteras, J.; Chorot, P.; Sandín, B. Sintomatología física y mental asociada al síndrome de burnout en los profesionales de la enseñanza. *Rev. Psicopatol. Psicol. Clin.* **2019**, *24*, 1136–1142. [CrossRef]
14. Eskic, J.; Kuhlmann, S.M.; Kreinbihl, K.; Hammerle, F. Mindfulness-based and cognitive-based stress prevention in student teachers (startklar): Study protocol of a randomised controlled trial. *BMJ OPEN* **2019**, *9*, e021941. [CrossRef]
15. Fan, L.; Ma, F.; Liu, Y.-M.; Liu, T.; Guo, L.; Wang, L.-N.; Fan, L.; Ma, F.; Liu, Y.-M.; Liu, T.; et al. Risk factors and resilience strategies: Voices from chinese novice foreign language teachers. *Front. Educ.* **2021**, *5*, 276. [CrossRef]
16. Fernández, A.L.; Rodríguez, D.S.; Aranda, M.J.G.; Paiz, A.L.; Saavedra, L.H. Estudio sobre las relaciones del síndrome de burnout con algunos factores psicosociales. *Reidocrea* **2015**, *4*, 94–99. [CrossRef]
17. Iglesias, S.L.; Azzara, S.H.; González, D.; Ibar, C.; Jamardo, J.; Berg, G.A.; Bargiela, M.M.; Fabre, B. Programa para mejorar el afrontamiento del estrés de los estudiantes, los docentes y los no docentes de la Facultad de Farmacia y Bioquímica de la Universidad de Buenos Aires. *Ansiedad Estres* **2018**, *24*, 105–111. [CrossRef]
18. Díez, J.C.; Álvaro, S.B.; Delgado, F.L.; Conchillo, C.M. Burnout, inteligencia emocional y rendimiento académico: Un estudio en alumnado de medicina. *Reidocrea* **2016**, *5*, 1–6. [CrossRef]
19. Díaz, F.; Gómez, I.C. La investigación sobre el síndrome de burnout en Latinoamérica entre 2000 y el 2010. *Psicol. Caribe* **2016**, *33*, 113–131. [CrossRef]
20. Méndez, I.; Martínez-Ramón, J.P.; Ruiz-Esteban, C.; García-Fernández, J.M. Latent profiles of burnout, self-esteem and depressive symptomatology among teachers. *Int. J. Environ. Res. Public Health* **2020**, *17*, 6760. [CrossRef] [PubMed]
21. López, S.M.; Extremera, N. Estado de la Cuestión Sobre Inteligencia Emocional y Burnout en el Profesorado por Países, Año de Publicación, Ciclos Educativos e Instrumentos de Evaluación. *Profr. Rev. Currículum Form. Profr.* **2017**, *21*, 371–389.
22. Mesurado, B.; Laudadio, J. Experiencia profesional, capital psicológico y engagement. Su relación con el burnout en docentes universitarios. *Propósitos Represent.* **2019**, *7*, 12–40. [CrossRef]
23. Burgos, A.L.V.; Paris, A.P.D.; Salcedo, A.G.S.; Arriagada, A.A. Bienestar psicológico y burnout en profesionales de atención primaria de salud en la región de Los Lagos, Chile. *Acta Univ.* **2018**, *28*, 56–64. [CrossRef]
24. De Vera, M.I.V.; Gambarte, M.I.G. Burnout y factores de resiliencia en docentes de educación secundaria. *Int. J. Sociol. Educ.* **2019**, *8*, 127–152. [CrossRef]
25. Salmela-Aro, K.; Hietajarvi, L.; Lonka, K. Work burnout and engagement profiles among teachers. *Front. Psychol.* **2019**, *10*, 2254. [CrossRef]
26. Van Der Want, A.C.; Brok, P.D.; Beijgaard, D.; Brekelmans, M.; Claessens, L.C.A.; Pennings, H.J.M. The relation between teachers' interpersonal role identity and their self-efficacy, burnout and work engagement. *Prof. Dev. Educ.* **2018**, *45*, 488–504. [CrossRef]
27. Ismail, A.A.; Sulaiman, T.; Roslan, S. Models of relationship between emotional, spiritual, physical and social intelligence, resilience and burnout among high school teachers. *Univers J. Educ. Res.* **2020**, *8*, 1–7. [CrossRef]
28. Haydon, T.; Alter, P.; Hawkins, R.; Kendall, C. "Check Yourself": Mindfulness-based stress reduction for teachers of students with challenging behaviors. *Beyond Behav.* **2019**, *28*, 55–60. [CrossRef]
29. García, M.I.V.D.V.; Gambarte, M.I.G. Associated factors with resilience and burnout: A cross-sectional study in a teaching group in Spain. *Aula. Abiert.* **2020**, *49*, 177–184. [CrossRef]

30. Grotberg, E.H. The international resilience project: Findings from the research and the effectiveness of interventions. In Proceedings of the Annual Convention of the International Council of Psychologist, Banff, AB, Canada, 24–28 July 1996.
31. Siebert, A. *The Survivor Personality*; Editorial Pedigree Books: New York, NY, USA, 1996.
32. Morales, F.M. Relaciones entre afrontamiento del estrés cotidiano, autoconcepto, habilidades sociales e inteligencia emocional. *Eur. J. Psychol. Educ.* **2017**, *10*, 41–48. [[CrossRef](#)]
33. Noreña, H. Estrés Académico y Estrategias de Afrontamiento en Estudiantes de Primer, Segundo y Tercer Semestre de la Facultad de Ingeniería de la Universidad de Antioquia. Master's Thesis, University of Antioquia, Medellín, Colombia, 2017. Available online: <https://bit.ly/375gY9i> (accessed on 11 July 2021).
34. Vizoso-Gómez, C.; Arias-Gundín, O. Resiliencia, optimismo y burnout académico en estudiantes universitarios. *Eur. J. Educ. Psychol.* **2018**, *11*, 47. [[CrossRef](#)]
35. Caycho-Rodríguez, T.; Ventura-León, J.; García-Cadena, C.H.; Tomás, J.M.; Domínguez-Vergara, J.; Daniel, L.; Arias-Gallegos, W.L. Evidencias psicométricas de una medida breve de resiliencia en adultos mayores peruanos no institucionalizados. *Interv. Psychosoc.* **2018**, *27*, 73–79. [[CrossRef](#)]
36. Daniilidou, A.; Platsidou, M.; Gonida, E. Primary school teachers' resilience: Association with teacher self-efficacy, burnout and stress. *Electron. J. Res. Educ. Psychol.* **2020**, *18*, 549–582. [[CrossRef](#)]
37. Pinel, C.; Martínez, J. Examining the link between reliance, burnout and stress. *EpSBS* **2019**, *60*, 582–591. [[CrossRef](#)]
38. Alarcón, M.E.B. *Estrés y Burnout Enfermedades en la Vida Actual*; Editorial Palibrio: Bloomington, IN, USA, 2018.
39. Zuluaga, D.M.M.; Hincapié, N.C.; Carmona, N.D.M. Enfrentándola ausencia de los padres: Recursos psicosociales y construcción de bienestar. *Rev. Colomb. Cienc. Soc.* **2016**, *7*, 181–200. [[CrossRef](#)]
40. Martínez-Martí, M.L.; Ruch, W. Character strengths predict resilience over and above positive affect, self-efficacy, optimism, social support, self-esteem, and life satisfaction. *J. Posit. Psychol.* **2016**, *12*, 110–119. [[CrossRef](#)]
41. Trigueros, R.; Padilla, A.; Aguilar, J.M.; Mercader, I.; López-Liria, R.; Rocamora, P. The influence of transformational teacher leadership on academic motivation and resilience, burnout and academic performance. *Int. J. Environ. Res. Public Health* **2020**, *17*, 7687. [[CrossRef](#)]
42. Goncalves, M. Capacidad y factores de resiliencia de niños y niñas en edad escolar. *Inves. Form. Pedag. Rev. CIEGC* **2017**, *3*, 26–44.
43. Olmo-Extremera, M.; Domingo, J. La resiliencia a partir de las relaciones profesionales en centros educativos desafiantes. *Educ. Formação* **2018**, *3*, 3–19. [[CrossRef](#)]
44. Vicente de Vera, M.I. Evaluación del Burnout y Factores de Resiliencia-Engagement en Docentes. Ph.D. Thesis, Universidad de Navarra, Pamplona, Spain, 2017.
45. Ragoonaden, K. SmarEducation: Developing stress management and resiliency techniques. *Learn. Landsc.* **2017**, *10*, 241–255. [[CrossRef](#)]
46. Curran, F.C.; Viano, S.L.; Fisher, B.W. Teacher victimization, turnover, and contextual factors promoting resilience. *J. Sch. Violence* **2017**, *18*, 21–38. [[CrossRef](#)]
47. Mansfield, C.F.; Beltman, S.; Broadley, T.; Weatherby-Fell, N. Building resilience in teacher education: An evidenced informed framework. *Teach. Teach. Educ.* **2016**, *54*, 77–87. [[CrossRef](#)]
48. Sanchez, C.D.; Almagia, E.B. Resiliencia y satisfacción laboral en profesores de colegios municipales y particulares subvencionados de la comuna de Machalí. *Estud. Pedagog.* **2017**, *43*, 75–86. [[CrossRef](#)]
49. Tacca, D.R.; Tacca, A.L. Síndrome de burnout y resiliencia en profesores peruanos. *Rev. Psicol.* **2019**, *22*, 11–30.
50. Ferradás, M.D.M.; Freire, C.; García-Bertoa, A.; Núñez, J.C.; Rodríguez, S. Teacher profiles of psychological capital and their relationship with burnout. *Sustainability* **2019**, *11*, 5096. [[CrossRef](#)]
51. Martínez, J.P. Cómo se defiende el profesorado de secundaria del estrés: Burnout y estrategias de afrontamiento [How secondary school teachers protect themselves from stress: Burnout and coping strategies]. *J. Work. Organ. Psychol.* **2015**, *31*, 1–9. [[CrossRef](#)]
52. Rico, A.; Ferrer, M.C.; Sánchez, S. Resiliencia versus síndrome del burnout en cuidadores de pacientes geriátricos. In *Perspectivas y Análisis de la Salud*; ASUNIVEP: Almería, Spain, 2016.
53. Sánchez, J.M.; Martínez, N.D.A.; Sahuquillo, M.L.; Román, A.C.; Cantó, M.M. Análisis de impacto de la crisis económica sobre el síndrome de Burnout y resiliencia en el personal de enfermería. *Enferm. Glob.* **2017**, *16*, 315–335. [[CrossRef](#)]
54. Franklin, G.; Martin, C.; Ruszaj, M.; Matin, M.; Kataria, A.; Hu, J.; Brickman, A.; Elkin, P.L. How the COVID-19 pandemic impacted medical education during the last year of medical school: A class survey. *Life* **2021**, *11*, 294. [[CrossRef](#)] [[PubMed](#)]
55. Kovacs, H.; Pulfrey, C.; Monnier, E.-C. Surviving but not thriving: Comparing primary, vocational and higher education teachers' experiences during the COVID-19 lockdown. *Educ. Inf. Technol.* **2021**, 1–25. [[CrossRef](#)]
56. Morales-Rodríguez, F.M.; Martínez-Ramón, J.P.; Méndez, I.; Ruiz-Esteban, C. Stress, coping, and resilience before and after COVID-19: A predictive model based on artificial intelligence in the university environment. *Front. Psychol.* **2021**, *12*, 647964. [[CrossRef](#)]
57. Gritsenko, V.V.; Reznik, A.D.; Konstantinov, V.V.; Marinova, T.Y.; Khamenka, N.V.; Isralowitz, R. Fear of coronavirus disease (COVID-19) and basic personality beliefs. *Клиническая Специальная Психология* **2020**, *9*, 99–118. [[CrossRef](#)]
58. Han, Y.; Jang, J.; Cho, E.; Choi, K.-H. Investigating how individual differences influence responses to the COVID-19 crisis: The role of maladaptive and five-factor personality traits. *Pers. Ind. Differ.* **2021**, *176*, 110786. [[CrossRef](#)] [[PubMed](#)]

59. Zettler, I.; Schild, C.; Lilleholt, L.; Kroencke, L.; Utesch, T.; Moshagen, M.; Böhm, R.; Back, M.D.; Geukes, K. The role of personality in COVID-19-related perceptions, evaluations, and behaviors: Findings across five samples, nine traits, and 17 criteria. *Soc. Psychol. Person. Sci.* **2021**, *1*–52. [[CrossRef](#)]
60. Qin, S.J.; Chiang, L.H. Advances and opportunities in machine learning for process data analytics. *Comput. Chem. Eng.* **2019**, *126*, 465–473. [[CrossRef](#)]
61. Hahn, G.; Ponce-Álvarez, A.; Deco, G.; Aertsen, A.; Kumar, A. Portraits of communication in neuronal networks. *Nat. Rev. Neurosci.* **2019**, *20*, 117–127. [[CrossRef](#)] [[PubMed](#)]
62. Ramón, J.P.M.; Rodríguez, F.M.M. What if violent behavior was a coping strategy? Approaching a model based on artificial neural networks. *Sustainability* **2020**, *12*, 7396. [[CrossRef](#)]
63. Salanova, M.; Schaufeli, W.B.; Llorens, S.; Peiró, J.M.; Grau, R. Desde el *burnout* al *engagement*: ¿Una nueva perspectiva? *J. Work. Organ. Psychol.* **2000**, *16*, 117–134.
64. Maslach, C.; Schaufeli, W.B.; Leiter, M.P. Job burnout. *Annu. Rev. Psychol.* **2001**, *52*, 397–422. [[CrossRef](#)]
65. Sinclair, V.G.; Wallston, K.A. The development and psychometric evaluation of the Brief Resilient Coping Scale. *Assessment* **2004**, *11*, 94–101. [[CrossRef](#)]
66. Moret-Tatay, C.; Fernández-Muñoz, J.J.; Civera-Mollá, C.; Navarro-Pardo, E.; Alcover-de-la-Hera, C. Propiedades psicométricas y estructura factorial del BRCS en una muestra de personas mayores españolas. *An. Psicol.* **2015**, *31*, 1030–1034. [[CrossRef](#)]
67. Longas, J.; Chamarro, A.; Riera, J.; Cladellas, R. La incidencia del contexto interno docente en la aparición del Síndrome del Quemado por el trabajo en profesionales de la enseñanza. *J. Work. Organ. Psychol.* **2012**, *28*, 107–118. [[CrossRef](#)]
68. Pando, M.; Castañeda, J.; Gregoris, M.; Águila, A.; Ocampo, L.; Navarrete, R.M. Factores psicosociales y síndrome de *burnout* en docentes de la Universidad del Valle de Atemejac, Guadalajara, México. *Salud Tabasco* **2006**, *12*, 523–529.
69. Guerrero, E.; Rubio, J.C. Fuentes de estrés y síndrome de *burnout* en orientadores de institutos de Enseñanza Secundaria. *Rev. Educ.* **2008**, *347*, 229–254.
70. Jurado, M.D.M.M.; Pérez-Fuentes, M.D.C.; Atria, L.; Ruiz, N.F.O.; Linares, J.J.G. Burnout, perceived efficacy, and job satisfaction: Perception of the educational context in high school teachers. *BioMed Res. Int.* **2019**, *2019*, 1021408. [[CrossRef](#)]
71. Hidalgo, J.; Acle, G.; García, M.; Tovalín, H. Burnout, resiliencia y compromiso laboral en maestros de educación especial. *Educ. Cienc.* **2019**, *8*, 48–57.
72. Forés, A.; Granés, J. *La Resiliencia. Crecer Desde la Adversidad*; Editorial Plataforma: Barcelona, Spain, 2008.