

Determining the Change of Physician Burnout During COVID-19 and Exploring Its Contributing Factors Based on the Empirical Study in 5 Hospitals of Suzhou, China

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ABSTRACT

Countless previous studies have manifested the negative consequences of physician burnout and its relating causes. However, the recent occurring pandemic, COVID-19, might change the whole picture for the problem. While hypothesizing that physician burnout changes before and after the pandemic and gender might play a role in such alteration, this study aimed to first explore changes of physician burnout during the pandemic and then identify contributing factors of such changes in Suzhou, a first tier city in China. Through an online survey to 1604 physicians at 5 hospitals locally, this research collected 790 effective responses (49.25% response rate). The survey delivered included two section: the revised version of Maslach burnout inventory (MBI) to test score changes before and after the pandemic for physicians and additional questions to determine possible factors that cause the alteration of physician burnout. Based on differences of the two sections, this study decided to perform quantitative analysis for the first section, mainly using pair-t test, Bowker test, multiple linear and logistic regression model, and qualitative analysis for the second one. The final results was basically consistent to the initial hypothesis. The results showed: overall, physician burnout increased during the pandemic; before and after the pandemic, gender and age were significantly associated with emotional exhaustion levels after COVID-19 after adjusting for other confounding factors. (before: gender ($p < 0.0001$), age ($p = 0.0096$); after: gender ($p < 0.0001$), age ($p = 0.0018$)) Specifically, this study discovered that male doctors aged from 30-49 experienced the most aggravation of symptoms in emotion exhaustion.

Keywords: Burnout, Emotional Exhaustion, Alteration, COVID-19, Suzhou, China.

1. INTRODUCTION

At present, due to continual exposure to great pressure given either by society or their families, physicians are frequently suffering from occupational burnout, which is defined as symptoms that cause depersonalization, emotional exhaustion, and a reduced sense of personal achievement[1]. This problem is widespread all over the world and has caused obvious negative impact on the medical field, which is manifested in the decline of medical quality, treatment safety, and patient satisfaction[2]. Despite the attention paid by some developed countries, the problem is essentially unsolved and continually occurring. In the United States, 50% of physicians were suffering from burnout in 2017 and the rate was still increasing by approximately 4% each year[3].

Physician burnout is induced by a number of reasons; such as gender, age, cultural norms, or workload; which are affected by contemporary issues and might be dependent on time and global events. Recently, the coronavirus disease 2019 (COVID-19) has had a profound impact across the world, causing massive illnesses and deaths. Under such a severe situation, doctors will likely receive a tremendous amount of work and responsibilities, often facing life-or-death situations, which may exacerbate pre-existing factors of burnout and bring about new ones. Yet, due to the recency of the event, reports that show the relationship between this new global pandemic and the burnout of physicians are particularly rare. In many of the developed countries where most of the previous burnout research was conducted, emergency conditions have caused those governments to allocate most of their resources to medical treatment rather than spend the

resources on data collection and research related to studying the effects of COVID-19 on physician burnout. Consequently, in China, a country that first experienced the outbreak of the pandemic and eventually had it effectively controlled, investigations on the effect of the pandemic on physician burnout are especially needed to lay a foundation for further research. Thus, the purpose of this research is to examine whether physician burnout was actually exacerbated or alleviated during the pandemic and to provide a more detailed description of possible causes for these changes.

2. LITERATURE REVIEW

Although governments of many countries have already placed a premium on the welfare of physicians, the problem of burnout is still occurring frequently around the globe. A number of studies recently measuring the burnout conditions of doctors have covered physicians from different specialties in different geographic areas, including dentists from Lithuanian, oncologists in Japan, doctors in Switzerland, and nurses in nine European countries; however, despite slight variations in results due to the differing situations, all studies illustrate the fact that these local physicians from various specialties in all parts of the world are mostly enduring exhaustion and burnout[4][5][6][7]. China is one of the places where the most severe problem takes place, as a recent report in 2020 from Nanjing Medical University suggests that about 40.8% of doctors in various specialties in primary care institutions suffer from serious professional burnout[8].

2.1. *Negative Consequences Associated with Physician Burnout*

Such frequent and wide appearances of burnout for physicians have induced significant negative consequences on the medical field and increased the number of major medical errors during treatments. A physiological study suggests that surgeons' level of burnout and quality of life are closely related to preliminary errors reported by themselves[9][10]. Moreover, the medical errors resulting from burnout of those surgeons could bring mental burden to them and cause subsequent distress; therefore, encouraging the formation of a vicious cycle which exacerbates the already severe condition[11]. As a result, patients, who tend to be exposed under these errors most frequently, would endure more medical risks under such circumstances. Previous research has effectively justified the relationship between the depersonalization of physician burnout with increasing risks of patients[2]. The validity of such a relationship was further confirmed by another study performed by a different group of researchers using surveys to investigate the feeling of depersonalization among physicians in affecting their levels of patient care[12].

Along with its harm to patients, physician burnout could also lead to great financial loss for the government, as it might encourage doctors who were cultivated and supported by the social welfare program to resign. In a multivariate probabilistic sensitivity analysis conducted in the United States, researchers estimated that the cost associated with physician turnover due to burnout symptoms could range from \$2.6 billion to \$6.3 billion each year. Specifically, the government would lose approximately \$7600 for every physician who resigned because of the burnout problem [13].

2.2. *Causes of Physician Burnout: External Factors*

Since the late twentieth century, the conspicuous negative effects of physician burnout on society have led many researchers to persistently investigate the contributing factors of the phenomenon in an attempt to discover its root cause, and in turn, use the root cause to find appropriate solutions to address this issue. Previous studies have found a number of causes related to physician burnout, laying a solid foundation for further research in this area. Although covering all the causes studied is neither possible nor the purpose of this literature review, it is important to illustrate the major external and internal causes of physician burnout that will help clarify the purpose of this research project.

This study first turned to literature exploring external factors of physician burnout, with external factors defined as the interaction of physicians with the surrounding environment in their lives. One of the main external causes could be the consensus view deeply rooted in cultural norms and perceptions of doctors. Traditionally, doctors are considered to be the most reliable and irreproachable figures who should not make any errors while fulfilling their occupational duties. As they are expected to exercise extreme levels of responsibility toward their patients without feeling fatigued, the socio-emotional health of doctors is often undermined compared to their patients' health problems. According to the results of a study based on 64 in-depth interviews done in Britain, such a deep cultural value could effectively prevent doctors from seeking and receiving proper help when depressed, which could indirectly increase the severity of accumulated negative emotions and ultimately lead to burnout symptoms[14].

In contrast to traditional values, modern technological innovations in the medical field have also been found to be associated with burnout symptoms. With the prevalence of electronic devices, many doctors nowadays use computer systems to help track the medical records of their patients[15]. Although electronic health records were invented for the purpose of making the storage of large amounts of medical data more convenient for further research in the medical

field, they could unintentionally lead to dissatisfaction among physicians and to burnout symptoms. A study by Stewart Babbott assessed the relationship between the number of electronic record functions, primary care work conditions, and physician burnout among 379 participants[16]. The results of the study show that moderate utilization of electronic records is correlated with lower satisfaction among physicians, revealing that an environment with stricter rules for electronic records could intensify the already low satisfaction of physicians, leading to more serious burnout symptoms. The conclusion of this study was recently verified by another group of researchers who conducted their study under a different methodology---by designing a time-motion survey. In addition to discovering a similar relationship between electronic records and burnout symptoms, the survey also revealed the fact that physicians tend to spend more time on filling out electronic records than on treating their patients[17]. In a single office day, an average of 27% of a doctor's time is spent facing patients, while 49.2% of it is spent filling out electronic documents and other desk work; according to a research by Christine Sinsky that investigated burnout conditions of physicians in 4 specialties: family medicine, internal medicine, cardiology, and orthopedics[18].

The effects of spending a substantial amount of time on electronic documents further exacerbate the condition of physician burnout by extending their work hours, as demonstrated in a recent survey where physicians complained about having to spend an extra one to two hours each night dealing with enormous amounts of "electronic" paperwork[15][18]. A cross-sectional study by Charles Balch et al. (2011) also utilized anonymous surveys to explore the negative effects of long work hours on surgeons[19]. The questionnaires distributed to a large sample of surgeons revealed that there is a positive, linear relationship between hours of work and burnout among surgeons, with correlations ranging from 30% for surgeons working 60 hours per week, 44% for those working 60 to 80 hours per week, and 50% for surgeons working 80 hours per week.

Moreover, research also has suggested that long work hours could lead to work-home conflict, which could be another possible factor influencing the extent of physician burnout. A study by Liselotte Dyrbye et al. (2011) found that long hours of work can induce more severe work-home conflicts, where each additional hour per week could lead to a conflict at home that lasts for approximately 3 weeks[20].

While work-home conflict could be the result of long working hours, the issue itself could also be a possible cause of physician burnout. Dyrbye et al. (2011) stated in the remaining results of their study that work-home conflict is associated with physician

burnout, and the results were supported by another study using email surveys to investigate the burnout and career satisfaction among physicians[21]. Although both studies employed surveys to explore the relationship, Dyrbye discovered her results through a multivariable analysis of data using a tool known as the Maslach Burnout Inventory (MBI). The MBI uses a numerical scale in a survey published two decades ago to assess the level of burnout in each occupation. Despite the differences in the methods employed by the two studies, the researchers still obtained similar results, which helps confirm the negative effects of this factor on physician burnout.

2.3. Causes of Physician Burnout: Internal Factors

A multitude of previous studies have also explored the internal factors of physician burnout, where internal factors are those that are relatively immutable characteristics of physicians; such as their age, gender, and specialty. Although these internal factors cannot be easily changed, it is important to consider these factors that may affect physician burnout, since it could help local governments identify the appropriate demographics or specialties of doctors that are most in need of government financial support. For instance, to most effectively mitigate the severity of overall physician burnout, a specific group of physicians associated with a certain characteristic, such as their age, could be allocated with the largest amount of subsidies by local governments to support their occupation.

As stated earlier, one of the potential internal factors could be a doctor's specialty. Previous research has revealed that physicians who work at the frontline; such as those in emergency medicine, internal medicine, and pediatric medicine; tend to have a higher possibility of reporting burnout symptoms[22]. This trend was later reconfirmed in a follow-up study conducted by Tait Shanafelt and other researchers with different participants during different time periods. In this study, among the 10 common occupations that experienced a significant increase (over 10%) in the burnout condition, the majority were specialties that either faced life-or-death situations or heavy workload at the frontline [23]. Based on this conclusion, those with occupations in the medical field are at high risk of suffering burnout.

Gender is another internal factor that might influence the burnout of physicians. In a research conducted by Dyrbye and her team, they found that female physicians, compared to their male colleagues, are more likely to endure more work-home conflict, a variable mentioned earlier in this literature review that could be associated with physician burnout[19][20]. A similar study also found that female physicians were in less control of their daily work; such as their patient

load, selection of doctor referrals, and details of office arrangement; where the overall unequal condition resulted in 1.6 times higher burnout possibilities for them as compared to male physician[24].

Some research also regard age as a significant factor associated with physician burnout. As Kosana Stanetic et al. (2013) claim in their research that assessed the burnout condition of family physicians, doctors over the age of 46 who have worked in the medical field for more than 21 years tend to have the most severe burnout conditions[25]. This finding was further supported by another research that studied both family and hospital doctors, in which physicians over 45 years old were confirmed to have significantly higher levels of emotional exhaustion than physicians at any other age [26].

In reality, in addition to the main causes mentioned above, there are countless contributing factors related to physician burnout which might also change under different circumstances. However, the majority of these past research was only conducted under normal circumstances rather than urgent situations.

Given this obvious gap in the literature, the motivation and purpose of this research is to discover possible factors associated with the current condition of physician burnout under the influence of a pandemic. As COVID-19 has just happened in China, few reports concerning its effect on the medical field exist. Consequently, it is a fairly new field which needs more research to be conducted. The fact that the majority of past research has only followed the traditional trend mentioned above, is the inconsistency where the research problem arises: What are the factors that contributed to the change of physician burnout during the pandemic? Based on previous literature, this study predicts that the burnout situation was exacerbated with varying levels of impact on doctors with different characteristics (such as gender and age). Perhaps female physicians would experience more burnout as a result of increased gender inequality in hospitals during the pandemic. This study also hypothesizes that workload, an external factor during the pandemic, might contribute to the change in burnout levels among physicians as well.

This study will investigate the burnout situation of medical professionals in Suzhou, one of the most developed cities in China, with the cooperation of the local medical system. This study first attempts to examine whether physician burnout was exacerbated or not during the pandemic and then further explores the contributing factors leading to burnout. Hopefully, it will contribute to this relatively new research area and serve as part of the foundation for further research on pandemics and their effects on doctors.

3. METHODOLOGY

3.1. Data Collection and Site Selection

The investigation was carried out through an online survey. Due to time constraints and geographic limitations, this study could only measure the burnout conditions of physicians in 5 hospitals of Suzhou. In addition, as the pandemic continued, the original plan to conduct face-to-face interviews with local doctors to learn about their working conditions and personal opinions on their occupation was canceled. The survey was released in online form using a Chinese survey collection website called WenJuanXing instead of in traditional paper form to guarantee the safety of participants and researchers. The link to the questionnaire was distributed through a Chinese social media platform known as WeChat. Through the help of some physicians, the link for the questionnaire was also sent to the labor union of each hospital in February 2021. Of the 1604 physicians who received the survey, 790 completed it, reaching a response rate of around 49.25%. The physicians were surveyed anonymously, and the data collection process lasted for eight days. The results of the data gathered from the survey were then translated into English.

3.2. Survey Design: Maslach Burnout inventory (MBI)

As mentioned in the literature review, most of the previous studies used surveys to assess physician burnout and its contributing factors, which was an effective methodology combining both quantitative and qualitative methods. While some researchers designed their own questionnaires and measurement standards, the majority employed the Maslach Burnout Inventory (MBI): a standard measurement of burnout problems--in their research. Published two decades ago, the MBI is composed of 22 items measuring the different ways that burnout is manifested and uses a numerical scale (0-6; 0: Never to 6: Every day) in each item to assess the extent of burnout. The survey can be further categorized into 3 main parts: emotional exhaustion, which contains 9 items with a score range from 0-54; depersonalization, which consists of 5 items with a score range of 0-30; and reduced personal accomplishment, which consists of 8 items with a score range of 0-48. In each part, different scores represent different conditions and severity. For example, a score between 19-26 in the emotional exhaustion section is considered as moderate level, while a score 26 is classified as severe level. Similarly, for the depersonalization part, a score ranging from 6-9 is considered as moderate level, with over 9 classified as severe level; and for the lack of personal achievement part, a score between 34-39 is considered as moderate level, while a score lower than 34 classified as severe level. Furthermore, when the scores of the

three categories all are classified as severe level, the participant is considered to have a high degree of occupational burnout[1]. Previous research has already demonstrated the accuracy as well as effectiveness of this method; thus, MBI has been widely employed in thousands of cases and considered as the optimal measurement method[27]. In order to ensure the validity of the results, this study also used surveys based on the MBI as the main measurement to conduct the experiment. For the first part of the questionnaire, this study made changes based on the previous Chinese-translated form of MBI.

3.3. Comparing MBI Before and After the Breakout of COVID-19

In order to show the amount of change in physician burnout due to COVID-19, each question with points ranging from 0-6 in the previous standard measurement tool was further redesigned into chart form into “Before” and “During” categories. The first list was designed to assess the condition before the pandemic, while the second was employed to assess the situation during the pandemic. Then, the differences between the scores and levels of the two lists could represent the change in physician burnout associated with COVID-19. Moreover, participants were initially informed at the top of the questionnaire, for surveying purposes, that the time of the pandemic mentioned in each question refers to the period from January 2020 to April 2020, when the situation of COVID-19 was considered to be most severe. Other parts of the charts were unchanged from the original version.

3.4. Additional Questions to Measure External and Internal factors

Considering the “effects of COVID-19” in this study refers to the combined effects of a series of complicated issues, this research incorporated specific questions to measure how internal factors and external factors are related to burnout into the second part of the survey to evaluate their relationship on the effects of COVID-19. Based on results and suggestions of previous research, three possible internal factors that might cause variation of physician burnout either in levels or scores during the pandemic were included in this section. These variables were, respectively, the gender, age, and specialties of physicians, with each variable independently shown as a question on the survey. Similarly, four possible external factors: social identity, workload, sleep quality, and family relationships: were also measured in the survey.

4. DATA ANALYSIS

The statistical analysis of the results in the study was done through a software package called SAS (version 9.4), a convenient programming tool for statistical

analysis. The overall descriptive analysis in this study was generated according to summary and depiction of both quantitative and qualitative data. In this study, quantitative data were described by the number of non-missing values, median, mean, standard deviation, minimum, and maximum as well as lower and upper quartiles. Since internal factors were assessed objectively in this study, their analysis was based on quantitative data, whereas external factors were evaluated subjectively, thus their analysis was based on qualitative data. To assess the change of physician burnout before and after COVID-19 quantitatively, referencing on results from charts of MBI, a paired t-test was utilized to explore the difference between the scores; and a Bowker test was used to determine the difference in levels to determine statistically significant differences ($p < 0.05$). Meanwhile, to explore the external factors, percentages of responses that respectively showed an increase, decrease, or no change for each item subjectively assessed in the survey were listed. On account of that, descriptive analysis of external factors was also made.

This study conducted multiple linear regression analysis to determine the predictive factors that could affect a change in scores before COVID-19 and after COVID-19. The potential factors were identified by the p-value from the results of the model. If the p-value was less than 0.05 based on the analysis, the variables (specialty, gender, and age) would be considered to have significant association with score changes during the COVID-19.

Similarly, multivariable polytomous logistic regression models were used to explore potential factors which could affect the levels of the three sub-items and total respectively. As with the above analysis, the potential predictive factors were identified by the p-value in the model. If the p-value was less than 0.05 based on the simple polytomous logistic regression analysis, the variables such as age or gender would be considered as possible predictors that have association with level changes of physician burnout during the pandemic.

5. RESULTS

In this study, a total of 790 doctors participated in and completed the survey. Nearly half (47.47%) of the doctors were 30 to 39 years of age, with 22.41% being 20 to 29 and 22.15% being 40 to 49 years of age. 529 (66.96%) were female and 261 (33.04%) were male.. Among all of the participants, 245 (31.01%) were in departments directly related to COVID-19, while 545 (68.99%) were in other departments which have no direct connection to COVID-19. Full demographic results are shown in Table 1.

Table 1. Demographic Results of Participants

Age (years)	n (%)
20-29	177 (22.41%)
30-39	375 (47.47%)
40-49	175 (22.15%)
50-59	58 (7.34%)
60 or above	5 (0.63%)
Gender	n (%)
Male	261 (33.04%)
Female	529 (66.96%)
Department	n (%)
Emergency room, fever outpatient department, etc. (departments directly related to COVID-19)	245 (31.01%)
Departments not directly related to COVID-19	545 (68.99%)

Based on the assessment of pair-test and Bowker test (Table 2), for the emotional exhaustion part, scores and levels both increased significantly during COVID-19.

Table 2. Assessment of Pair-test and Bowker Test

	Before COVID-19	After COVID-19	P value
Emotional Exhaustion			<.0001*
n (missing)	790 (0)	790 (0)	
mean ± SD	26.9 ± 11.57	29.8 ± 12.26	
Median	27	30	
Q1, Q3	18, 35	21, 39	
Min, Max	0, 54	0, 54	
Emotional Exhaustion, n (%)			<.0001#
Low	203 (25.70%)	162 (20.51%)	
Moderate	159 (20.13%)	130 (16.46%)	
High	428 (54.18%)	497 (63.04%)	
Depersonalization			<.0001*

n (missing)	790 (0)	790 (0)	
mean ± SD	9.1 ± 6.97	9.5 ± 7.33	
Median	8	8	
Q1, Q3	4, 14	4, 15	
Min, Max	0, 30	0, 30	
Depersonalization, n (%)			0.1177#
Low	292 (36.96%)	288 (36.46%)	
Moderate	165 (20.98%)	160 (20.25%)	
High	333 (42.15%)	342 (43.29%)	
Lack of Personal Accomplishment			0.0009*
n (missing)	790 (0)	790 (0)	
mean ± SD	31.7±8.38	32.0±8.32	
Median	31	32	
Q1, Q3	26, 38	27, 38	
Min, Max	0, 48	0,48	
Lack of Personal Accomplishment, n (%)			0.3267#
Low	156 (19.75%)	164 (20.76%)	
Moderate	163 (20.63%)	165 (20.89%)	
High	471 (59.62%)	461 (58.35%)	
Maslach Burnout Inventory overall, n (%)			0.0243#
High	193 (24.43%)	210 (26.58%)	

* paired t-test # Bowker test

For the depersonalization part, there was an increase in scores after COVID-19. However, no significant difference was found in levels between before and after the pandemic.

For the lack of personal accomplishment part, a slight increase in scores was observed after the pandemic. However, no significant difference was found in its levels.

As for overall Maslach Burnout Inventory (MBI), there was a significant difference between the two periods. More participants were assessed as high in MBI after COVID-19, compared with before COVID-19.

As all three categories had differences in scores before and after the pandemic, potential internal factors that affect score changes need to be assessed for these categories. For each, this study used multiple linear regression to analyze the influencing factors. Table 3 shows the details of the variables considered. Let Y1, Y2, Y3 be the dependent variables representing the scores in emotional exhaustion, depersonalization, and the lack of personal accomplishment, respectively. X1, X2, X3 are the independent variables indicating the gender, age, and department of the doctors surveyed.

Table 3. Multiple linear Regression Analysis Variable Assignment

Variable	Assignment instructions
Y1 (Emotional Exhaustion)	Emotional Exhaustion Score
Y2 (Depersonalization)	Depersonalization Score
Y3 (Lack of Personal Accomplishment)	Lack of Personal Accomplishment Score
X1 (Gender)	Male=1 , Female=2
X2 (Ages)	20-29=1 , 30-39=2 , 40-49=3 , 50-59=4 , 60 or above=5
X3 (Department)	Emergency department =1, Other departments =2

After regressing the three independent variables (gender, age, and department) against the emotional exhaustion score (Y1) during the COVID-19 pandemic, results (Table 4-6) showed that only the gender and age had statistically significant differences between the two periods. This study then used the stepwise method to select the variables using the criterion of having a p-value < 0.05.

Table 4. Summary of Stepwise Selection

Step	1
Variable Removed	X3
Label	department
Variable Entered	2
Partial R-Square	0.0009
Model R-Square	0.0374
C(p)	2.7100
F Value	0.71
Pr>F	0.3997

Table 5. Analysis of Variance

Source	Model	Error	Corrected
DF	2	787	789
Sum of Squares	4443.16447	114215	118658
Mean Square	2221.58223	145.12657	
F Value	15.31		
Pr>F	<.0001		

Table 6. Parameter Estimate

Variable	Intercept	X1	X2
Label	Intercept	gender	age
DF	1	1	1
Parameter Estimate	33.29331	-3.90007	1.42568
Standard Error	2.04816	0.92189	0.49430
T Value	16.26	-4.23	2.88
Pr> t	<.0001	<.0001	0.0040
Variance Inflation	0	1.02349	1.02349

According to the variance analysis results, the overall F value of the equation is 15.31, corresponding to a p-value less than 0.01, so this study reject the original hypothesis that the equation is statistically significant. Based on the results of progressive regression, the statistically significant coefficients that remained are gender (X1) and age (X2), which gives us the final equation shown below:

$$Y_1 = 33.29 - 3.90X_1 + 1.43X_2 \tag{1}$$

This research followed the same methodology for the depersonalization and the lack of personal accomplishment scores, running multiple linear regression equations using the same three independent variables for the corresponding scores. The details for each of the dependent variables, depersonalization and lack of personal accomplishment are shown in Table 7-9, and Table 10-12, respectively.

Table 7. Summary of Stepwise Selection

Step	1	2
Variable Removed	X3	X2
Label	Department	Age
Variable Entered	2	1
Partial R-Square	0.0005	0.0018
Model R-Square	0.0552	0.0534
C(p)	2.4258	1.8939
F Value	0.43	1.47
Pr>F	0.5142	0.2258

Table 8. Analysis of Variance

Source	Model	Error	Corrected
DF	1	788	789
Sum of Squares	2267.30609	40178	42445
Mean Square	2267.30609	50.98754	
F Value	44.47		
Pr>F	<.0001		

Table 9. Parameter Estimate

Variable	Intercept	X1
Label	Intercept	gender
DF	1	1
Parameter Estimate	15.50985	-3.60181
Standard Error	0.93691	0.54013
T Value	16.55	-6.67
Pr> t	<.0001	<.0001
Variance Inflation	0	1.00000

Table 10. Summary of Stepwise Selection

Step	1
Variable Removed	X1
Label	gender
Variable Entered	2
Partial R-Square	0.0002
Model R-Square	0.0119
C(p)	2.1293
F Value	0.13
Pr>F	0.7192

Table 11. Analysis of Variance

Source	Model	Error	Corrected
DF	2	787	789
Sum of Squares	648.52669	53957	54606

Mean Square	324.26334	68.56093	
F Value	4.73		
Pr>F	0.0091		

Table 12. Parameter Estimate

Variable	Intercept	X2	X3
Label	Intercept	age	Gender
DF	1	1	1
Parameter Estimate	32.42944	0.82639	-1.30903
Standard Error	1.28701	0.33693	0.63901
T Value	25.20	2.45	-2.05
Pr> t	<.0001	0.0144	0.0408
Variance Inflation	0	1.00663	1.00663

The results (Table 7-9) showed that only gender is statistically significant for measuring depersonalization among doctors. The final equation expression for measuring the correlation between depersonalization and gender is shown below:

$$Y_2 = 15.51 - 3.60X_1 \tag{2}$$

From the results shown in Table 10-12, age was taken out of the equation, with gender and department remaining as the significant factors affecting the scores measuring the lack of personal accomplishment:

$$Y_3 = 32.43 + 0.83X_2 - 1.31X_3 \tag{3}$$

For the level changes, only the emotional exhaustion part showed significant differences. Thus, the three internal factors were assessed in the multiple polytomous logistic regression models to show the final results in the situation before the pandemic. For the situation after the pandemic, the same process was followed to show the statistically factors that affected the scores of emotional exhaustion. After that, comparisons of the situation before and after the pandemic were made (Table 13). The specific steps for calculations and comparisons are listed below.

Table 13. Multiple polytomous logistic analysis variable assignment

Variable	Assignment instructions
Y (Emotional Exhaustion Level)	Emotional score<19=low, Emotional score(19-26)= moderate, Emotional score>26=high
X1 (Gender)	Male=1 , Female=2

X2 (Ages)	20-29=1 , 30-39=2 , 40-49=3 , 50-59=4 , 60 or above=5
X3 (Department)	Emergency department =1, Other departments =2

First, multivariable polytomous logistic regression was carried out to measure the effects of the three independent variables on the emotional exhaustion among doctors before COVID-19. Again, the stepwise method was used to find the relevant independent variables. The results (Table 14-16) showed that only gender from the overall test situation of the model, the corresponding p-value of each test value of the model is less than 0.01, meaning that the model can be considered to be significantly effective.

Table 14. Summary of Stepwise Selection

Step	1
Effect Removed	X3
DF	1
Number In	2
Wald Chi-Square	1.2745
Pr>Chisq	0.2589
Lable	department

Table 15. Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr>Chisq
Likelihood ratio	28.0029	2	<.0001
Score	27.1783	2	<.0001
Wald	26.9775	2	<.0001

Table 16. Analysis of Maximum Likelihood Estimates

Parameter	Intercept	Intercept	X1	X2
	moderate	low		
DF	1	1	1	1
Estimate	-2.0366	-0.7926	0.6331	-0.2086
Standard Error	0.3455	0.3389	0.1538	0.0805
Wald Chi-Square	34.7451	5.4718	16.9473	6.7085
Pr>Chisq	<.0001	0.0193	<.0001	0.0096

From the gradual regression results, running the model after the elimination of non-statistically significant variables gave us the final equation expression below (the probability accumulation of the level "high"):

$$\logit(P_{Y1-before}) = -2.83 + 0.63X_1 - 0.21X_2 \quad (4)$$

Final multivariable model results showed that gender (p<0.0001) and age (p= 0.0096) were significantly associated with emotional exhaustion levels before COVID-19, adjusting for the possible confounding of other factors. A similar process was followed for the emotional exhaustion levels after COVID-19 with details shown in Table 17-19, giving us a final equation of:

$$\logit(P_{Y1-during}) = -3.790.81 + X_1 - 0.27X_2 \quad (5)$$

Table 17. Summary of Stepwise Selection

Step	1
Effect Removed	X3
DF	1
Number In	2
Wald Chi-Square	2.3925
Pr>Chisq	0.1219
Lable	department

Table 18. Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr>Chisq
Likelihood ratio	39.9247	2	<.0001
Score	38.3782	2	<.0001
Wald	36.8283	2	<.0001

Table 19. Analysis of Maximum Likelihood Estimates

Parameter	Intercept	Intercept	X1	X2
	moderate	low		
DF	1	1	1	1
Estimate	-2.4644	-1.3327	0.8064	-0.2693
Standard Error	0.3774	0.3700	0.1688	0.0863
Wald Chi-Square	42.6331	12.9755	22.8145	9.7468
Pr>Chisq	<.0001	0.0003	<.0001	0.0018

Final multivariable model results showed that gender (p<0.0001) and age (p=0.0018) were significantly associated with emotional exhaustion levels after COVID-19 after adjusting for other confounding factors. Overall, our results found that age and gender were considered as the most relevant

internal determinants of the level changes in the emotional exhaustion scores of doctors before and after the pandemic. Specifically, this study found that male doctors aged from 30-49 experienced the most aggravation of symptoms in emotion exhaustion.

Other external factors related with COVID-19 were also assessed. Compared with before COVID-19, 180 (22.78%) participants believed that social identity for doctors increased and 246 (31.14%) participants thought workload also increased after COVID-19. Meanwhile, sleep quality of 139 (17.59%) doctors decreased after COVID-19. As participants self-assessed, there was no significant change in their relationship with families and friends before and after COVID-19. The full results are shown in Table 20.

Table 20. External factors

n (%)	Change between before COVID-19 and after COVID-19
Social identity for doctors	
Decrease	24 (3.04%)
Equal	586 (74.18%)
Increase	180 (22.78%)
Work load	
Decrease	54 (6.84%)
Equal	490 (62.03%)
Increase	246 (31.14%)
Sleep quality	
Decrease	139 (17.59%)
Equal	582 (73.67%)
Increase	68 (8.74%)
Relationship with families and friends	
Decrease	75 (9.49%)
Equal	656 (83.04%)
Increase	59 (7.47%)

6. DISCUSSION

The results of the study show that the scores changed in all three categories, indicating a trend that

physician burnout increases after a pandemic. However, in assessment of level changes, among the three categories, only the emotional exhaustion part had a significant increase. The reason behind this might be correlated to China's national conditions and policies in dealing with COVID-19. Although this research was limited to only physicians working in 5 hospitals in Suzhou, Jiangsu Province, where the number of patients was not comparatively much during the pandemic, the complicated procedures for safety were still necessary and continuously performed in every hospital. Moreover, during that time, patients who had a fever or symptoms similar to COVID-19 would be immediately regarded as potential risks and sequestered to a special department for further treatment. Given a high number of patients, such as children who had a fever due to seasonal changes, physicians had to deal with even more tedious and monotonous work on top of pre-existing duties, such as endlessly measuring patients' temperatures, assessing the patients' recent situations and exposure, and guiding the patients to special treatment areas. Thus, while receiving an incessant and repetitive workload due to COVID-19, their symptoms for emotion exhaustion might be aggravated.

However, in the measurement, the scores of the third section of MBI, the lack of personal achievement part---slightly increased, showing that the symptoms of physician burnout in this section was actually alleviated during COVID-19. This inconsistency might be attributed to the increasing amount of work due to the national policies as mentioned above, where physicians might feel a sense of personal achievement as they were finishing even more tasks. Nevertheless, the results also show that the levels for both depersonalization and reduced sense of personal accomplishment remained the same. This study speculates that possible reasons for the lack of significant changes in these two categories might be the counter-effect of society and the physicians' surrounding environment. As discussed above, the pandemic could bring more workload as well as pressure to physicians. However, at that time period, all the Chinese media ceaselessly showed the contribution and valuable characteristics of physicians, regarding them as heroes of the nation who would sacrifice their lives to fight against the pandemic. Under such circumstances, physicians would probably feel a sense of pride for their occupation and patriotism towards their country.

For the internal factors assessed in this study, only gender and age were shown to have an association with the increasing levels of emotional exhaustion among physicians during the pandemic. Specifically, male doctors aged 30-49 were discovered to have the most severe increase in level of emotion exhaustion before and after the pandemic. The reason for this phenomenon still remains unclear; however, based on previous studies, this research infers that male doctors had to take

more responsibility during the pandemic, and male doctors aged 30-49 were commonly tasked with fighting the pandemic. Therefore, they were required to complete more tasks with higher expectations. Both of these speculated cases could result in greater exhaustion for physicians.

For the external factors associated with a change in physician burnout, the results of the study show that during COVID-19, 22.78% of the doctors surveyed reported that their social identity increased; 31.14% of the doctors thought their workload increased; and 17.59% of the doctors reported that their sleep quality decreased. These results are consistent with the overall trend proposed by this study. However, as all external factors were assessed subjectively without confirmation from statistical models, the results for this part might not precisely reflect the real situation from a scientific perspective, which weakens their overall persuasiveness. Thus, using more complicated scientific methods, future studies could further examine the validity of these factors as contributing to physician burnout during the pandemic.

7. CONCLUSION

In conclusion, this study successfully achieved its primary objectives of identifying the trend of burnout change during the pandemic and exploring factors that contribute to this trend. The results of the study are mostly consistent with the hypothesis proposed that physician burnout would increase during the pandemic due to both external and internal reasons, with gender being a key indicator. Specifically, male physicians were proved to experience a higher increase in emotional exhaustion levels. Overall, the most significant findings of this research are that gender and age are the two significant contributing factors of changes in emotional exhaustion levels of physician burnout during a pandemic.

Due to time and geographic constraints, this study could only focus on situations in Suzhou, a first tier city in China. As a result, this study cannot accurately predict and represent the whole picture of the alteration in burnout condition in China. Meanwhile, since the research was conducted when the pandemic was reoccurring, considering the safety of both participants and the researcher, this study only utilized online surveys to investigate the problem without having face-to-face interviews with local doctors as previously planned. While analyzing results of the survey, the relationship between external factors and alteration in physician burnout lacked further statistical confirmation and in-depth qualitative evidence.

Given the limitations mentioned, future research could be conducted on a larger scale with more participants in other regions in order to improve

accuracy as well as significance. Moreover, when assessing the influence of external and internal factors, more possible factors discovered under normal circumstances such as frequency of night work, culture norms, and usage of electronic documents could be brought up in the survey. In terms of assessing external factors, methods with greater accuracy and scientific value could be implemented to replace the descriptive analysis of subjectively assessed data utilized in this study. Hopefully, this study could serve as a foundation for further research on a pandemic's effect on doctors in different areas.

REFERENCES

- [1] Maslach, C., Jackson, S.E., & Leiter, M.P. (1996). *Maslach Burnout Inventory Manual* (3rd ed.). Palo Alto, CA: Consulting Psychologists Press.
- [2] Panagioti, M., Geraghty, K., Johnson, J., Zhou, A., Panagopoulou, E., Chew-Graham, C., ... & Esmail, A. (2018). Association between physician burnout and patient safety, professionalism, and patient satisfaction: a systematic review and meta-analysis. *JAMA internal medicine*, 178(10), 1317-1331.
- [3] Peckham, C. (2017). *Medscape lifestyle report 2017: race and ethnicity, bias and burnout; 2017*.
- [4] Aiken, L. H., Sloane, D. M., Bruyneel, L., Van den Heede, K., Griffiths, P., Busse, R., ... & Sermeus, W. (2014). Nurse staffing and education and hospital mortality in nine European countries: a retrospective observational study. *The lancet*, 383(9931), 1824-1830.
- [5] Arigoni, F., Bovier, P. A., & Sappino, A. P. (2010). Trend of burnout among Swiss doctors. *Swiss Medical Weekly*, 140(3132).
- [6] Mampuya, W. A., Matsuo, Y., Nakamura, A., & Hiraoka, M. (2017). Evaluation of the prevalence of burnout and psychological morbidity among radiation oncologist members of the Kyoto Radiation Oncology Study Group (KROSG). *Journal of radiation research*, 58(2), 217-224.
- [7] Puriene, A., Aleksejuniene, J., Petrauskiene, J., Balciuniene, I., & Janulyte, V. (2008). Self-perceived mental health and job satisfaction among Lithuanian dentists. *Industrial health*, 46(3), 247-252.
- [8] Zhang, X., Liu, W. N., & Zhu, B. H. (2020). Current situation and influencing factors of general practitioners' job burnout in primary medical institutions. *Chinese Journal of Medical Management Sciences*, 10(5), 26-31.
- [9] Balch, C. M., Shanafelt, T. D., Dyrbye, L., Sloan, J. A., Russell, T. R., Bechamps, G. J., &

- Freischlag, J. A. (2010). Surgeon distress as calibrated by hours worked and nights on call. *Journal of the American College of Surgeons*, 211(5), 609-619.
- [10] Shanafelt, T. D., Balch, C. M., Bechamps, G., Russell, T., Dyrbye, L., Satele, D., ... & Freischlag, J. (2010). Burnout and medical errors among American surgeons. *Annals of surgery*, 251(6), 995-1000.
- [11] West, C. P., Huschka, M. M., Novotny, P. J., Sloan, J. A., Kolars, J. C., Habermann, T. M., & Shanafelt, T. D. (2006). Association of perceived medical errors with resident distress and empathy: a prospective longitudinal study. *Jama*, 296(9), 1071-1078.
- [12] Halbesleben, J. R., & Rathert, C. (2008). Linking physician burnout and patient outcomes: exploring the dyadic relationship between physicians and patients. *Health care management review*, 33(1), 29-39.
- [13] Han, S., Shanafelt, T. D., Sinsky, C. A., Awad, K. M., Dyrbye, L. N., Fiscus, L. C., ... & Goh, J. (2019). Estimating the attributable cost of physician burnout in the United States. *Annals of internal medicine*, 170(11), 784-790.
- [14] McKeivitt, C., & Morgan, M. (1997). Illness doesn't belong to us. *Journal of the Royal Society of Medicine*, 90(9), 491-495.
- [15] Shanafelt, T. D., Dyrbye, L. N., Sinsky, C., Hasan, O., Satele, D., Sloan, J., & West, C. P. (2016, July). Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. In *Mayo Clinic Proceedings* (Vol. 91, No. 7, pp. 836-848). Elsevier.
- [16] Babbott, S., Manwell, L. B., Brown, R., Montague, E., Williams, E., Schwartz, M., ... & Linzer, M. (2014). Electronic medical records and physician stress in primary care: results from the MEMO Study. *Journal of the American Medical Informatics Association*, 21(e1), e100-e106.
- [17] Young, R., Burge, S., Kumar, K., Wilson, J., & Ortiz, D. (2018). A time-motion study of primary care physicians' work in the electronic health record era. *Family medicine*, 50(2), 91-99.
- [18] Sinsky, C., Colligan, L., Li, L., Prgomet, M., Reynolds, S., Goeders, L., ... & Blike, G. (2016). Allocation of physician time in ambulatory practice: a time and motion study in 4 specialties. *Annals of internal medicine*, 165(11), 753-760.
- [19] Dyrbye, L. N., Shanafelt, T. D., Balch, C. M., Satele, D., Sloan, J., & Freischlag, J. (2011). Relationship between work-home conflicts and burnout among American surgeons: a comparison by sex. *Archives of surgery*, 146(2), 211-217.
- [20] Dyrbye, L. N., West, C. P., Satele, D., Sloan, J. A., & Shanafelt, T. D. (2011). Work/home conflict and burnout among academic internal medicine physicians. *Archives of Internal Medicine*, 171(13), 1207-1209.
- [21] Glasheen, J. J., Misky, G. J., Reid, M. B., Harrison, R. A., Sharpe, B., & Auerbach, A. (2011). Career satisfaction and burnout in academic hospital medicine. *Archives of Internal Medicine*, 171(8), 782-790.
- [22] Shanafelt, T. D., Boone, S., Tan, L., Dyrbye, L. N., Sotile, W., Satele, D., ... & Oreskovich, M. R. (2012). Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Archives of internal medicine*, 172(18), 1377-1385.
- [23] Shanafelt, T. D., Gorringer, G., Menaker, R., Storz, K. A., Reeves, D., Buskirk, S. J., ... & Swensen, S. J. (2015, April). Impact of organizational leadership on physician burnout and satisfaction. In *Mayo Clinic Proceedings* (Vol. 90, No. 4, pp. 432-440). Elsevier.
- [24] SGIM Career Satisfaction Study Group. (2000). The work lives of women physicians: Results from the Physician Work Life Study. *Journal of General Internal Medicine*, 15(6), 372-380.
- [25] Stanetić, K., & Tešanić, G. (2013). Influence of age and length of service on the level of stress and burnout syndrome. *Medicinski preglad*, 66(3-4), 153-162.
- [26] Stanetić, K. D., Savić, S. M., & Račić, M. (2016). The prevalence of stress and burnout syndrome in hospital doctors and family physicians. *Medicinski preglad*, 69(11-12), 356-365.
- [27] Schaufeli, W. B., Bakker, A. B., Hoogduin, K., Schaap, C., & Kladler, A. (2001). On the clinical validity of the Maslach Burnout Inventory and the Burnout Measure. *Psychology & health*, 16(5), 565-582.
- [28] Kim, S. K., Woo, J. W., Lee, J. H., Park, I., Choe, J. H., Kim, J. H., & Kim, J. S. (2016). Prophylactic central neck dissection might not be necessary in papillary thyroid carcinoma: analysis of 11,569 cases from a single institution. *Journal of the American College of Surgeons*, 222(5), 853-864.