Hu et al. BMC Health Services Research (2025) 25:772
https://doi.org/10.1186/s12913-025-12942-z

BMC Health Services Research

RESEARCH

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Exploring the impact of workplace violence on defensive medicine and patient outcomes: an empirical analysis using regression discontinuity

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Abstract

Objective This study aims to thoroughly examine the impact of workplace violence incidents in healthcare settings on the structure of medical expenses, with a particular focus on specific changes in defensive medical, and to further investigate the resulting patient outcomes.

Method This study examines a high-profile workplace violence incident in W City, H Province, China, which had widespread societal impact, treating it as an exogenous shock. Utilizing inpatient medical record data from W City, the study constructs a regression discontinuity model to systematically analyze shifts in medical behaviors related to costs and decision-making following the incident, as well as the implications of these changes on patient burden and health outcomes.

Results The findings indicate that workplace violence incidents lead to significant changes in the structure of medical costs, with a notable increase in comprehensive medical service fees and a significant decrease in invasive treatment fees. Further analysis reveals that such incidents trigger pronounced defensive medicine, including extended hospital stays, increased probabilities of departmental transfers, reduced surgical levels, and higher costs and a greater proportion of traditional Chinese medicine in total expenditures. Additionally, in terms of patient outcomes, workplace violence incidents slightly alleviate patients' out-of-pocket expenses and payment ratios. However, these incidents significantly worsen patients' primary health indicators and overall health status at discharge.

Conclusion Workplace violence against healthcare professionals significantly impact the structure of medical costs and trigger defensive medicine, characterized by a tendency toward conservative treatment approaches and reduced treatment intensity. While such incidents may partially alleviate patients' financial burdens, they have detrimental effects on patients' health outcomes. Therefore, to enhance healthcare quality and safeguard patient well-being, it is imperative to implement measures to mitigate workplace violence in healthcare and encourage medical institutions to prioritize scientific and rational decision-making in treatment practices.

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Keywords Workplace violence, Workplace violence against healthcare professionals, Defensive medicine, Patient outcomes

Introduction

Workplace violence (WPV) is a pervasive global issue, particularly prevalent in industries involving intensive interpersonal interaction, with the healthcare sector being notably affected [1, 2]. The phenomenon of violence targeting physicians, nurses, and other healthcare personnel is longstanding [3]. High frequencies of WPV against healthcare professionals have been documented globally: 30% in the United States [4], 9.5% in England [5], 36.4% in Japan [6], 91.4% in Jordan [7], 67.4% in Saudi Arabia [8], 85.2% in Turkey [9], and 66.8% in China [10]. Research indicates that nearly 25% of violent incidents—including physical violence, verbal abuse, and sexual harassment—occur within healthcare systems [11], with healthcare professionals being 16 times more likely to encounter violence than professionals in other industries [12]. These findings underscore the alarming prevalence of violence within healthcare settings.

According to expected utility theory, individuals faced with multiple choices evaluate the expected utility of each option, calculated as the product of each outcome's value and its likelihood, and typically select the option with the highest expected utility. WPV against healthcare professionals significantly alters the expectations of both medical professionals and patients, eroding mutual trust. This phenomenon affects not only the attitudes and quality of care provided by healthcare professionals but also influences patients' demand for and utilization of medical services, disrupting the equilibrium of the healthcare supply-demand system [13, 14]. A survey of physicians in Jordan by Alhamad et al. [15]revealed that 72% of respondents reported a decline in job performance due to WPV. There is a broad consensus that WPV against healthcare professionals induces defensive medicine among medical professionals.

Specifically, in the course of clinical practice, healthcare providers may adopt defensive "safety" decisions—such as restructuring medical expenditure or modifying treatment processes—not necessarily in the best interest of patients, but rather as a means of self-protection, to avoid disputes and litigation, and to mitigate the potential threat of WPV against healthcare professionals [16, 17]. Such decisions often deviate from the principle of maximising the principal's (i.e., the patient's) welfare, giving rise to what is known as defensive medicine [18, 19]. Existing literature broadly categorises defensive medicine into two types. The first is positive defensive medicine, which involves the excessive use of medical services—such as ordering unnecessary tests, procedures, or medications—to generate a defensive record and demonstrate due diligence in the event of potential disputes [20, 21]. The second is negative defensive medicine, which manifests as avoidance or restriction of care—such as reluctance to treat high-risk patients, reduction in complex procedures, or referral to other institutions—to evade potential liability and conflict [22].

Although defensive medicine has been extensively discussed and categorised at the theoretical level, there remains a lack of systematic empirical evidence concerning the specific behavioural changes it induces under WPV scenarios, and the resulting economic and health-related consequences. Most existing studies rely on qualitative approaches—such as surveys and structured interviews—to examine the impacts of WPV against healthcare professionals. A smaller body of literature uses administrative data and proxies, such as medical malpractice incident rates, to explore the cost-effectiveness or health impacts of defensive medicine. However, few studies have quantitatively assessed the direct impact of WPV on medical costs and patient outcomes. Several recent review papers further confirm this gap, highlighting the generally low level of evidence and the paucity of rigorous quantitative analyses in this field [13, 23–25]. Therefore, there is a pressing need to conduct robust quantitative evaluations of the economic and health effects resulting from WPV against healthcare professionals.

Existing research predominantly employs qualitative methods, such as questionnaire surveys and structured interviews, to elucidate the consequences of WPV against healthcare workers. A limited number of studies have utilized empirical data, with medical malpractice incidence rates serving as proxy indicators, to examine the cost-effectiveness and health outcomes of defensive medicine. However, few studies have quantitatively analyzed the impact of WPV on healthcare costs and health outcomes, particularly in the context of event-based associations. Numerous review studies corroborate this viewpoint, highlighting the overall low level of evidence and the scarcity of quantitative research in this field [13, 25, 26]. Therefore, it is essential to conduct a quantitative analysis of the costs and health outcomes associated with WPV against healthcare professionals.

Scientifically quantifying and validating the effects of WPV against healthcare professionals presents numerous challenges. Many scholars regress medical disputes or instances of violence on medical expenses to observe potential defensive medicine among healthcare professionals [19, 27]. However, this approach faces several endogeneity issues: Firstly, medical costs are influenced by various factors, including policy adjustments, changes in patient demand, and broader economic conditions. Violence against healthcare professionals is just one of many contributing factors. Using changes in medical costs as a measure makes it challenging to isolate the specific impact of such violence and accurately attribute it to defensive medicine.Secondly, medical expenses consist of different categories, such as diagnostic fees, treatment fees, and pharmaceutical fees, with the direction and magnitude of the impact of violence varying across these categories. Using total medical expenses as the dependent variable may obscure offsetting effects between categories, leading to misinterpretations of the overall effect. Thirdly, the impact of violence on medical expenses primarily reflects changes in healthcare spending and may not accurately capture the defensive characteristics of physician behavior. This simplistic measurement method does not fully account for the complexity of defensive medicine.Finally, high medical costs themselves may provoke patient dissatisfaction with medical institutions, potentially exacerbating medical disputes or incidents of WPV against healthcare professionals. This reverse causality complicates the directionality of regression analyses, rendering causal interpretations challenging.

Thus, while fluctuations in medical expenses offer theoretical value and preliminary insights into defensive medicine, endogeneity issues undermine the reliability of the conclusions, resulting in mixed findings. An urgent need exists for more systematic and precise quantitative research to overcome these methodological limitations and to deeply explore the specific impact of violence against healthcare professionals on defensive medicine and patient welfare.To address these limitations, this study uses WPV incidents as exogenous shocks and constructs a regression discontinuity model to investigate their impacts on the structure of medical costs, medical behaviors, and patient outcomes. This approach not only offers empirical support for healthcare system reform and optimization but also provides policymakers with a scientific basis for protecting the rights of both healthcare providers and patients. Ultimately, it seeks to improve the overall efficiency of the healthcare system, foster harmonious doctor-patient relationships, and promote the sustainable improvement of the healthcare environment.

Background and research hypothesis

Background

On December 14, 2018, in W City, H Province, China, a criminal suspect, Zeng, entered a tertiary hospital armed with a knife and attempted to commit a violent act against a physician. The suspect repeatedly stabbed Dr. Zhang, causing severe injuries to the head, neck, and chest, and rupturing major abdominal blood vessels, leaving Dr. Zhang in critical condition. On the same day, the H Province People's Government, the Provincial Health Commission, and the Provincial Medical Association issued official statements condemning this heinous act of WPV.

Multilevel public security systems at the provincial, municipal, and district levels, along with health authorities, organized task forces to address the case and ensure the maintenance of a safe medical environment. Meanwhile, renowned media outlets, including People's Daily Online, The Paper, Global Times, and Sohu News, provided extensive coverage of the incident, which quickly garnered significant attention from the medical community and the general public.Using this incident as an exogenous shock, this study investigates changes in medical behaviors, particularly those related to costs and decision-making, following WPV. It also examines the resulting impacts on patient burden and health outcomes.

Research hypothesis

Doctors and patients embody a classic principal-agent relationship. Under conditions of complete information symmetry and absence of externalities, their goals align: achieving the optimal treatment level that maximizes patient utility within resource constraints. However, due to the highly specialized and technical nature of the healthcare sector, doctors, as agents, hold substantial informational advantages in terms of prescription authority and medical expertise. Conversely, patients, as principals, often face significant informational disadvantages. This inherent imbalance makes the doctor-patient principal-agent relationship heavily dependent on mutual trust, introducing a natural instability.When WPV against healthcare professionals occurs, the already fragile trust between doctors and patients deteriorates further. The heightened perception of medical risks drives both parties to adopt strategic behaviors in response, fundamentally altering their interactions' dynamics.

From the perspective of healthcare providers, violence against medical staff not only causes physical harm but inflicts even more severe psychological trauma. When such incidents occur, the risks and consequences borne by healthcare professionals can be overwhelming, which may in turn trigger defensive medicine. On the one hand, physicians may increase the use of unnecessary tests or procedures to protect themselves from liability and to establish a trail of "evidence of due diligence" [20, 21]. On the other hand, due to concerns about further violent encounters, doctors may reduce the use of invasive treatments in an effort to minimise patients' pain perception and alleviate the emotional pressure on family members—thereby lowering the likelihood of conflict during the treatment process [22].

Moreover, WPV against healthcare professionals imposes additional costs on hospitals in terms of security and workforce replacement, which indirectly drives up healthcare expenditure [28, 29]. For instance, Aljohani et al. found that among every 10,000 hospital employees, the average number of absence days due to WPV was 14.7 for healthcare workers, compared to only 2.8 for non-healthcare staff [25]. According to Grossman & Choucair, U.S. hospitals spend as much as $4.7 billion annually on security, with approximately 18% of this amount (around $847 million) specifically allocated to preventing WPV [30].

From the perspective of patients, WPV against healthcare professionals increases psychological burdens, heightening fear and distrust in the medical environment. This may lead patients to choose lower-intensity treatments or question the treatment plans recommended by doctors, thereby reducing their demand for high-intensity care. Lower-intensity treatments are often associated with reduced medical service costs, which, to some extent, alleviates patients' financial burdens. Furthermore, patients' strategic responses to such violence may indirectly reinforce defensive medicine among healthcare professionals, further altering the dynamics of the doctor-patient relationship.

WPV against healthcare professionals may significantly impact patient health outcomes by influencing patients' risk perception, doctors' occupational risks, and work-related stress. Specifically, such violence can affect patient health outcomes through two mechanisms: On one hand, defensive medicine triggered by WPV may lead doctors to spend more time communicating with patients, increase treatment intensity, improve care standards, and conduct additional diagnostic tests. These actions contribute to more comprehensive medical documentation for future reference, minimize error rates, and, in certain cases, save patients' lives [31].On the other hand, WPV can adversely affect patients' health and well-being. The severity of violent acts directly threatens healthcare professionals' physical safety and mental health, exacerbating their occupational stress [13, 32]. In environments marked by burnout and psychological anxiety, WPV significantly increases the incidence of medical errors and post-surgical complications, hindering high-risk patients from receiving appropriate care. This diminishes the quality of healthcare services and negatively impacts patient health outcomes [24, 33].Furthermore, WPV can distort individual doctors' willingness to practice and reduce the overall supply of medical professionals [34, 35]. This leads to significant negative externalities in resource allocation and healthcare service utilization, ultimately undermining patients' overall health outcomes [36, 37].

However, a small number of studies suggest that WPV against healthcare professionals does not exhibit a significant association with patient health outcomes. For example, Dubay et al. [38] found that although fear of medical malpractice led doctors to delay or reduce the frequency of prenatal visits, it did not result in noticeable adverse effects on maternal delivery outcomes. Similarly, while heightened medical malpractice pressure may lead doctors to pay more attention to patient health, the improvements in health outcomes resulting from such pressure are often minimal and lack statistical significance [39, 40]. These findings suggest that the relationship between WPV and patient health outcomes may be influenced by sample selection bias. Studies focusing on specific diseases or populations might not fully capture broader groups or diverse clinical scenarios.

Therefore, the following hypothesis is proposed:

H1: WPV may alter the structure of medical expenses by increasing comprehensive medical service costs while reducing invasive treatment costs. This occurs as healthcare providers adopt conservative treatment strategies to mitigate potential risks of violence.

H2: WPV is associated with a decline in patient health outcomes.

Methods

Data source and sample selection

This study is based on administrative data from the medical insurance settlement platform of H Province, China. All data were fully anonymized and de-identified before being accessed by researchers, ensuring that no personally identifiable information was included. According to the relevant provisions of the "Personal Information Protection Law of the People's Republic of China", the "Data Security Law of the People's Republic of China", and the "Ethical Review Measures for Biomedical Research Involving Human Subjects", research using anonymized administrative data does not involve the direct recruitment of human participants and therefore does not require ethical approval or informed consent. Furthermore, this study complies with the principles of the "Declaration of Helsinki".A stratified sampling method combined with systematic sampling was employed. After stratifying by city in H Province, patients were sorted by discharge month, and systematic sampling was conducted at equal intervals. The data from each city layer were then merged to form the final sample.

The sample for this study is from W City, H Province, in 2018 and 2019. The initial sample size was 20,040, which was reduced to 7,514 after applying the time window. The data adhere to the standards of inpatient medical records provided by the National Health Commission of China, including patient personal characteristics, diagnostic and treatment information, and medical costs. Personal information includes case number, name, gender, date of birth, age, and place of origin. Diagnostic and treatment information includes admission condition, pathological diagnosis, discharge diagnosis, disease code, admission department, surgery and procedure codes, and more. Medical costs include payment method, total hospitalization cost, out-of-pocket costs, and various types of medical services such as diagnostic, therapeutic, and rehabilitative services.

This study uses inpatient medical record data structured as repeated cross-sectional data ordered by admission date, where each observation represents a single hospitalization episode for an individual patient, accompanied by admission and discharge timestamps. Although the dataset does not constitute a panel structure tracking the same patient over time, the presence of precise time stamps enables the application of a regression discontinuity in time (RDit) design. To minimize the impact of other factors and enhance comparability with the control group, the time range for the sample from W City, H Province, was set between August 1, 2018, and April 30, 2019. The rationale for the time window limitation is based on several considerations: Time window around WPV events: A 4-month window before and after the WPV against healthcare professionals was selected to capture the direct short-term effects on medical behavior and costs. This period is sufficient to observe initial reactions from healthcare institutions and patients while being short enough to minimize interference from unrelated factors, ensuring a more accurate assessment of the event's impact. Controlling external confounding factors: Limiting the time window reduces the influence of long-term policy changes, economic fluctuations, or seasonal diseases on the results, allowing the focus to remain on the event's impact. Buffering period: WPV events can prompt strategic actions by hospitals and doctors, such as enhanced security measures, process changes, and psychological interventions for staff. These adjustments take time to influence medical behavior and costs. The 4-month window captures these longer-term effects in addition to the immediate responses. Research feasibility: A 4-month time span ensures a sufficient sample size for statistical power and allows detailed examination of the effects of medical violence on costs, behaviors, and patient health outcomes.

After processing, the final sample size for W City was 5,709. To avoid interference from outliers, this study applied a 1% winsorization to all cost data.

Indicator selection and measurement methodology

Dependent variable

Medical costs Medical costs include Total Medical Costs, Comprehensive Service Fees, Diagnosis Fees, Treatment Fees, and Pharmaceutical Fees. Total Medical Costs refer to the sum of all medical expenses incurred by the patient during hospitalization. Comprehensive Service Fees include general medical service fees, general treatment operation fees, nursing fees, rehabilitation fees, and more. Diagnosis Fees encompass pathological diagnosis fees, laboratory examination fees, imaging examination fees, clinical diagnostic item fees, and disposable medical material costs for examinations. Treatment Fees include non-surgical treatment project fees, surgical treatment fees, and disposable medical materials used in treatments or surgeries. Pharmaceutical Fees cover costs for western medicine, traditional Chinese medicine (TCM), and proprietary Chinese medicines.

Defensive medicine To comprehensively measure defensive medicine, this study classifies relevant indicators into two dimensions: healthcare utilisation behaviour and clinical decision-making behaviour. The selection of indicators draws on existing literature and considers their theoretical relevance to risk-averse or liability-avoidance tendencies in clinical practice [41, 42]. In terms of healthcare utilisation, we employ three indicators: length of hospital stay, number of hospital admissions, and the 31-day readmission rate. Prolonged hospital stays may reflect overly cautious observation beyond clinical necessity, while frequent admissions or rapid readmissions within a short timeframe may indicate excessive defensive behaviour or fragmented care stemming from risk avoidance. Regarding clinical decision-making, we focus on three key variables: department transfer, surgical complexity, and use of TCM. A department transfer is defined as a case in which the discharge department differs from the admission department, potentially indicating that the physician avoided treating complex or uncertain cases. Surgical complexity is graded from 0 (no surgery) to 4 (most complex surgery), enabling us to assess whether physicians are inclined to avoid high-risk procedures. The use of TCM is measured by both the total expenditure on TCM, including herbal and proprietary medicines, and the proportion of TCM costs in overall medical expenditure. A higher proportion may suggest a preference for lower-risk treatment alternatives in place of more aggressive interventions.

Additionally, to assess the potential economic implications of defensive medicine for patients, we include two indicators of financial burden: out-of-pocket expenditure and the out-of-pocket ratio, reflecting the absolute cost borne by the patient and the share of that cost relative to the total hospital bill, respectively.

Health outcomes Health outcomes are measured using discharge diagnosis, which reflects the patient's health status at discharge. Discharge outcomes are categorized as 1 (cured), 2 (improved), 3 (not cured), and 4 (death). The primary health indicator is based on the primary diagnosis at discharge. To offer a more comprehensive perspective, the study calculates an average of the discharge statuses for both the primary diagnosis and additional diagnoses, forming a measure of comprehensive health. For clarity, these values are reversed, so higher values indicate better patient health conditions.

Core explanatory variable

The core explanatory variable is whether the sample is affected by a medical violence incident, represented by a dummy variable (RD). A value of 0 is assigned if the sample period is before December 14, 2018, and 1 otherwise.

Control variables

Apart from the core explanatory variable, this study incorporates several control variables. Payment method refers to how patients pay for medical costs, such as employee health insurance, urban-rural resident insurance, or out-of-pocket payments. Visit urgency is indicated as emergency (=1) or non-emergency (=0). The ACCI index (Age-Adjusted Charlson Comorbidity Index) evaluates the severity of a patient's condition and mortality risk, calculated by summing weighted scores based on disease codes and age. Additional control variables include gender and marital status. The descriptive statistical analysis is presented in Table 1.

Results

WPV and medical costs

Before estimating using the regression discontinuity design, it is necessary to first determine whether a discontinuity effect exists at the breakpoint. In this study, if there is a noticeable jump or fluctuation in medical costs at the breakpoint, it is likely attributable to the WPV against healthcare professionals event. Figures 1, 2, 3, 4 and 5 plot the polynomial-fitted curves of mean total medical costs. A noticeable fluctuation in medical costs at the breakpoint indicates that the event had an effect on medical costs. However, whether this effect is statistically significant requires further estimation using the regression discontinuity model

Table 2 reports the regression results on the impact of WPV against healthcare professionals on healthcare costs. The significance of the treatment effect RD coefficient indicates significant group differences in the effect of WPV against healthcare workers across different types of healthcare costs. Although Total Medical Costs show a slight increase (3.6%) after the WPV against healthcare workers event, this effect is not statistically significant.Looking at the itemized costs, column (2) results show that the treatment effect RD coefficient is statistically significant at the 1% level, with a 20.2% increase in Comprehensive Service Fees. This suggests a significant positive effect of WPV against healthcare professionals on comprehensive service fees. When Treatment Fees are the dependent variable, column (4) results show that the RD coefficient for the treatment effect is significantly

Table 1 Descriptive statistical analysis

Variable Name	Sample Size	Mean	Standard Deviation	Maximum	Minimum
Total Medical Costs	5709	10.89	0.74	7.98	11.71
Comprehensive Service Fees	5,704	8.99	0.77	5.09	10.10
Diagnosis Fees	5,709	8.85	1.05	3.69	10.06
Treatment Fees	5,709	7.77	3.01	0	11.27
Pharmaceutical Fees	5,709	9.01	1.42	5.66	10.58
Payment Method	5,709	1.62	0.82	1	3
Marriage	5,709	0.63	0.48	0	1
Gender	5,709	1.49	0.50	1	2
Comprehensive Health	5,675	3.16	0.54	1	4
Primary Health	5,593	3.21	0.61	1	4
Out-of-pocket Ratio	5,691	0.30	0.38	0	1
Surgical Levels	5,709	1.29	1.53	0	4
Emergency	5,709	0.13	0.33	0	1
ACCI	5,709	2.65	2.50	0	9
Length Of Stay	5,709	3.95	0.41	1.39	5.10
Number Of Hospitalizations	5,709	0.49	0.83	0	2.94
The 31-day Readmission Rate	5,657	0.32	0.47	0	1
Department Transfer	5,709	0.18	0.38	0	1
Out-of-pocket Amount	2,987	9.84	1.24	-0.29	10.62
Traditional Chinese Medicine Cost	3,715	6.34	1.66	-0.16	8.27
Traditional Chinese Medicine Proportion	5,709	0.01	0.02	0	0.36

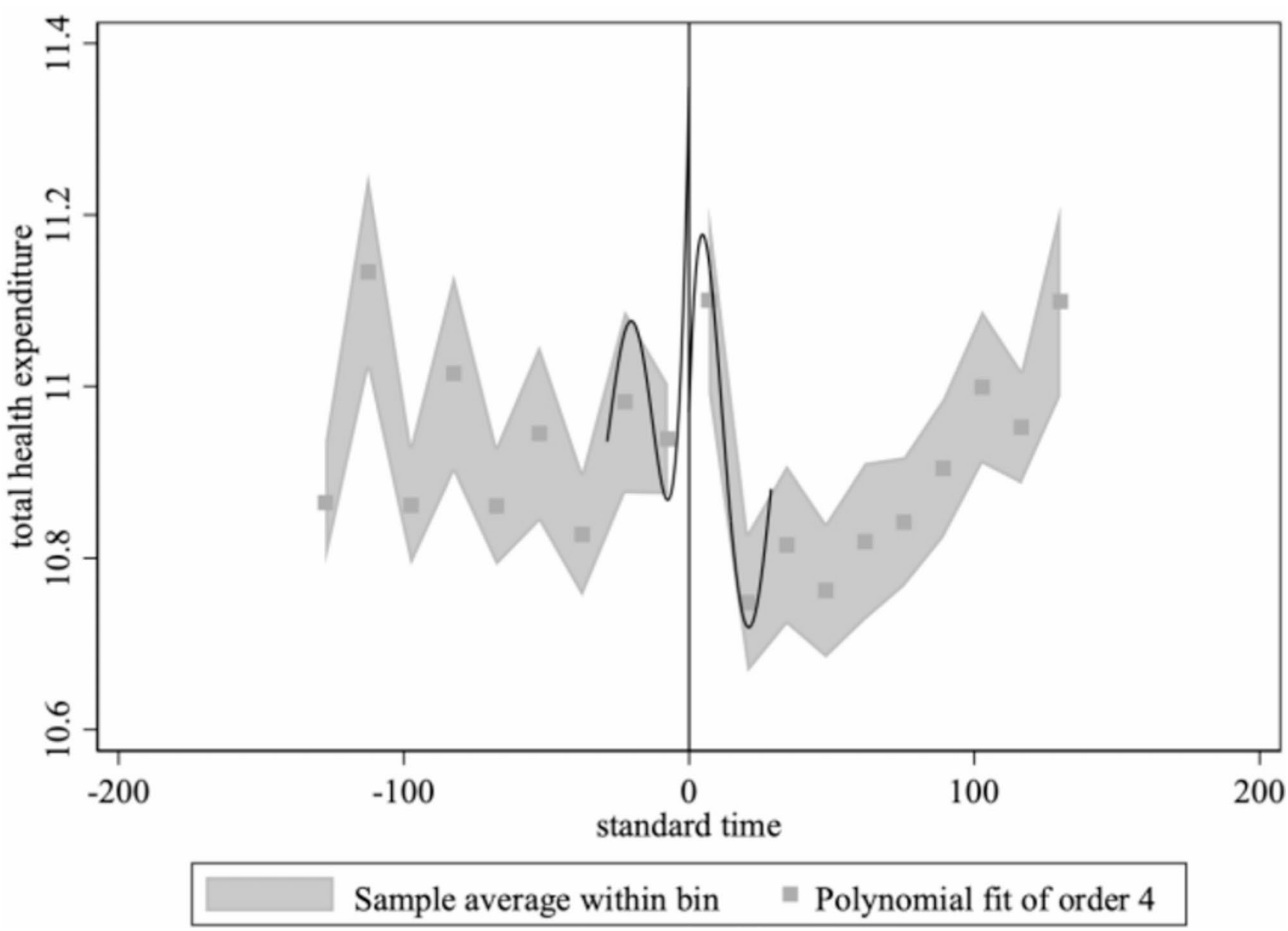

Fig. 1 Polynomial fitting curve for the total health expenditure

negative at the 1% level. This suggests that after a WPV against healthcare workers event, hospitals may adjust medical practices, such as reducing high-risk or high-cost procedures. When Diagnostic Fees and Pharmaceutical Fees are the dependent variables, the results in columns (3) and (5) show that the interaction term coefficients are not statistically significant.

Defensive medicine

Table 3 reports the estimated results for the specific manifestations of defensive medicine and patient outcomes caused by WPV against healthcare professionals. Defensive medicine primarily manifests in healthcare utilization and the medical process. Specifically, the results in columns (1) and (2) show that the treatment effect RD coefficient is significantly positive at the 1% level, with the length of stay and the number of hospitalizations increasing by 12.0% and 21.2%, respectively, after the occurrence of WPV against healthcare workers. This indicates that such events lead hospitals to adopt more cautious treatment strategies, increasing hospitalization duration and frequency to reduce risk. The results in column (3) show that the treatment effect RD coefficient is not significant, indicating that WPV against healthcare workers does not have a significant effect on readmission within 31 days and does not alter the likelihood of patients being readmitted in the short term.

In terms of the treatment process, the estimated coefficients of the treatment effect RD are significant in all regression equations, indicating that WPV against healthcare professionals has a significant impact on medical behavior, particularly in medical decision-making. This is reflected by more departmental transfers, more conservative surgical decisions, and increased use of TCM. The results in column (4) show that the treatment effect RD coefficient is significantly positive at the 5% level, with the probability of departmental transfers increasing by 3.6%. This indicates that after medical violence, doctors adopted more departmental transfer measures. The results in column (5) show that the treatment effect RD coefficient is significantly negative at the 5% level, with surgical levels decreasing by 18.7%. This indicates that after the occurrence of violence, surgical decisions became more conservative, reducing high-risk surgeries and invasive treatments. The results in columns (6) and (7) show that the treatment effect RD coefficients

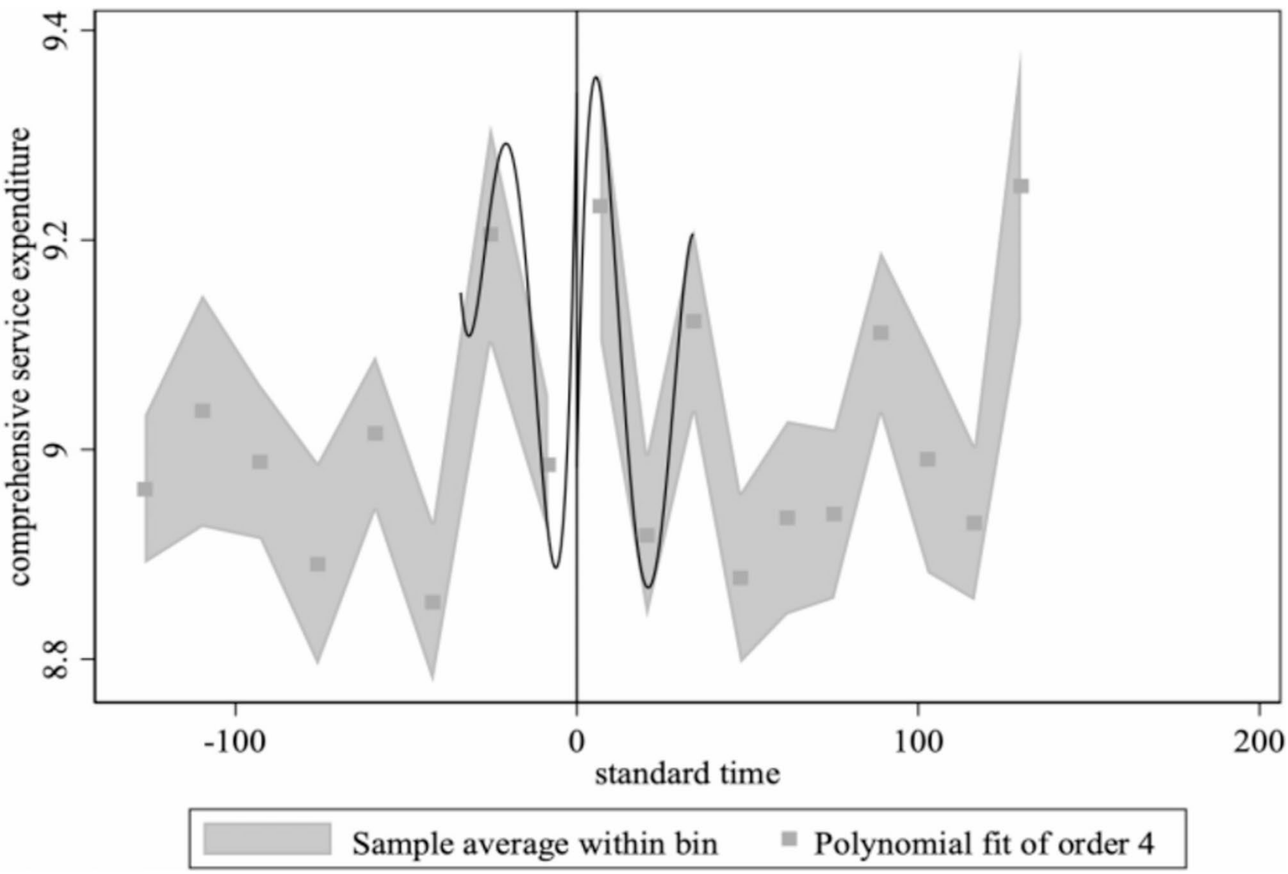

Fig. 2 Polynomial fitting curve for the comprehensive expenditure

are significantly positive at the 5% level, with TCM costs and their proportion of total medical expenses increasing by 50.4% and 0.3%, respectively. This suggests that after WPV against healthcare professionals, hospitals increasingly used traditional Chinese medicine, possibly due to its perception as a safer treatment option. Overall, doctors exhibit passive defensive medicine in their treatment decisions. Hypothesis 1 is partially validated.

In terms of patient outcomes, columns (8) to (11) report changes in patient burden and health outcomes following WPV against healthcare workers. The treatment effect RD coefficients are significantly negative in all regression equations, indicating that violence not only increases patients' economic burden but also negatively impacts their health outcomes. The results in columns (8) and (9) show that the treatment effect RD coefficients are significant at the 10% and 1% levels, with the out-of-pocket ratio and out-of-pocket amount decreasing by 4.0% and 41.3%, respectively. This indicates that negative defensive medicine following medical violence led to reductions in patients' out-of-pocket costs. The results in columns (10) and (11) show that the treatment effect RD coefficients are significant at the 5% and 10% levels, with comprehensive health and primary health declining by 8.8% and 7.9%, respectively. This suggests that after WPV against healthcare professionals, patients' discharge health status significantly deteriorated, likely because medical staff, out of risk-aversion concerns, adopted more conservative treatment strategies, thereby reducing health outcomes. Hypothesis 2 is partially validated.

Robustness check

Exclude the sample during the spring festival period

Influenced by traditional Chinese culture, patients admitted during the Spring Festival holiday may experience unstable fluctuations in medical costs due to differences in the severity of their conditions. This study excludes samples from five days before the Spring Festival (February 5, 2019) to fifteen days after the festival and reruns the regression analysis. After excluding this special period, Table 4 results show that, compared to the baseline regression, the absolute values of the treatment effect RD coefficients for comprehensive service fees and treatment fees slightly decrease but remain significant. This indicates that even after excluding the data from the Spring Festival period, the results remain stable.

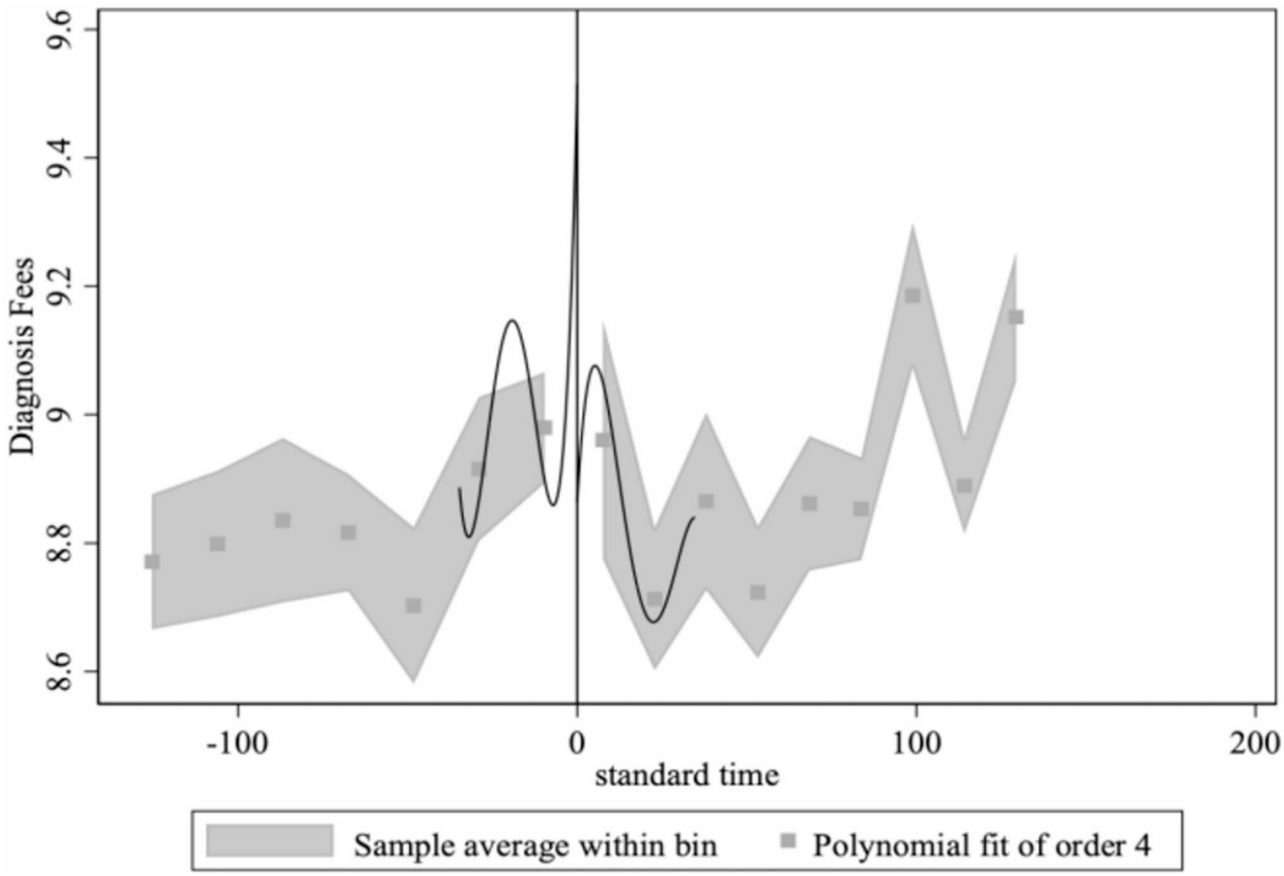

Fig. 3 Polynomial fitting curve for the diagnosis fees

Varying the time window

To ensure that the results are not driven by the specific choice of a four-month window, we conducted additional robustness checks by both expanding and narrowing the time window. Specifically, we extended the window to five and six months on either side of the cutoff, and also tested shorter windows of three and two months. As reported in Table 5, the estimated RD coefficients across all five outcome variables remain stable in both magnitude and direction, with key effects—particularly on comprehensive service fees and treatment fees—consistently maintaining statistical significance. These findings indicate that our results are robust to alternative window specifications and further strengthen the credibility of the identification strategy.

Covariate balance test

To verify the comparability of samples before and after the cutoff point, this study conducted a covariate balance test on key patient characteristics. Taking 14 December 2018 as the threshold, the sample was divided into treatment and control groups. We examined differences in means and standardised mean differences (SMDs) for the following variables: Payment Method, Marriage, Comprehensive Health, Gender, Surgical Levels, Emergency, and ACCI.

As shown in Table 6, most covariates do not exhibit statistically significant differences in means across the cutoff point ($P > 0.05$), and all corresponding SMDs are below 0.1, indicating a high degree of overall balance. Only Comprehensive Health and Surgical Levels slightly exceed the 0.1 threshold, yet remain within the widely accepted upper bound of 0.2 in empirical research.

To further assess the continuity assumption required by the RDiT design, we plotted local regression graphs for all seven covariates (see Figs. 6 and 7). The results show that Marriage, Gender, Emergency Admission, and ACCI follow smooth trends with no visible discontinuities at the threshold. Payment Method exhibits slight fluctuations but no structural break. In contrast, both Comprehensive Health and Surgical Levels display clear discontinuities around the cutoff point.

Although the SMD statistics suggest that overall comparability is not materially compromised, the observed structural jumps imply potential threats to identification validity. To address this concern, we adopted two robustness strategies. First, we re-estimated the main regression model after excluding Comprehensive Health and

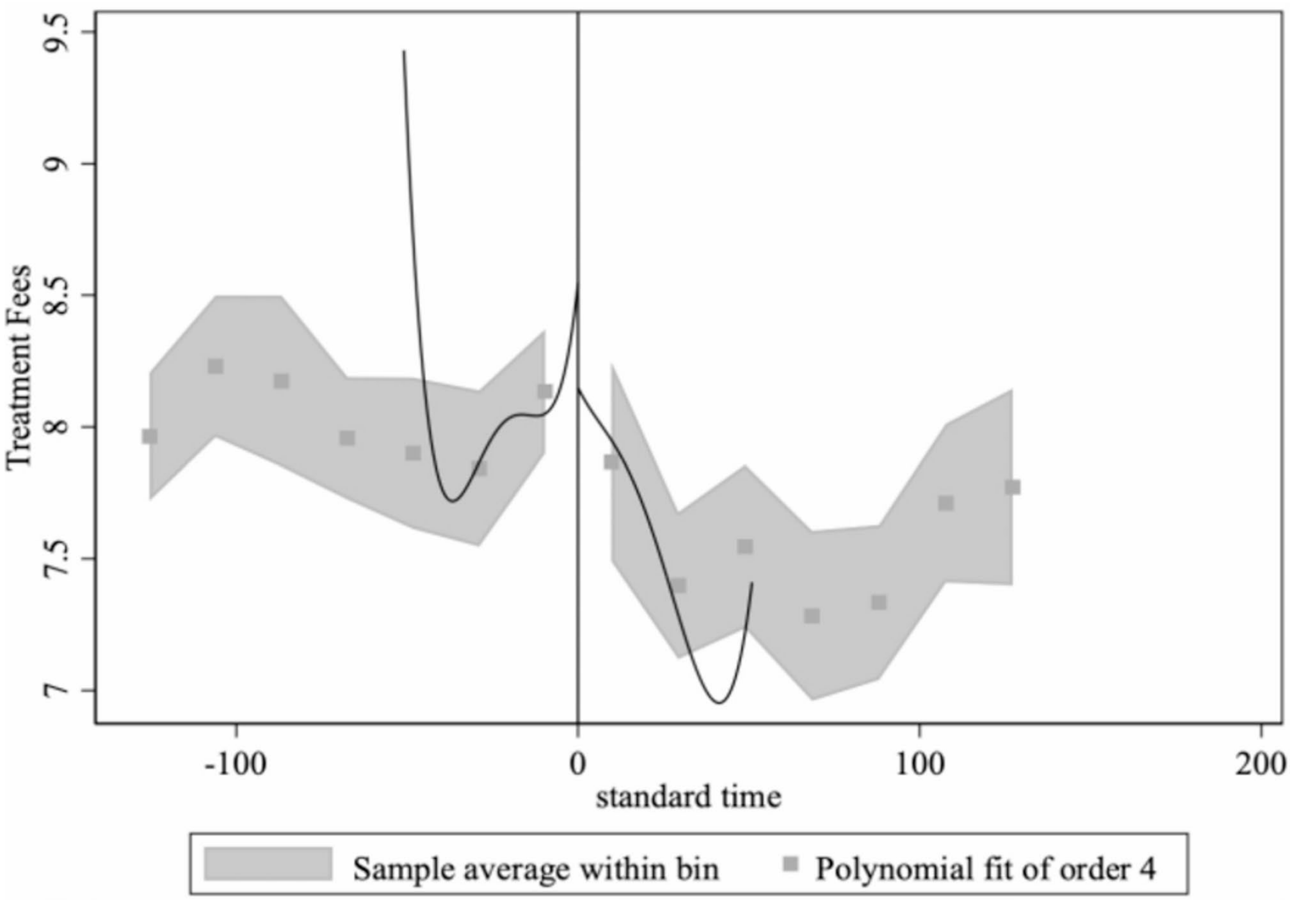

Fig. 4 Polynomial fitting curve for the treatment fees

Surgical Levels, the two covariates with clear discontinuities. As shown in Table 7, the core variables that were previously statistically significant remain significant with consistent directionality, indicating that the key findings are robust to model specification and not driven by potentially endogenous covariates. Second, we further elaborated on this identification risk in the limitations section, noting that even minor discontinuities in covariates may compromise causal inference. We recommend that future studies consider adopting covariate-adjusted local randomisation approaches to strengthen identification.

Overall, the statistical tests, graphical diagnostics, and sensitivity analyses jointly confirm that the samples on either side of the cutoff point are broadly comparable, thereby lending credibility to the causal identification under the RDiT framework.

"Donut" RD

To assess whether the regression results are influenced by observations immediately surrounding the cutoff, this study follows Barreca et al. [43] and implements a "donut" regression discontinuity analysis, excluding observations within ± 5 days of the cutoff date. This approach helps to mitigate potential bias arising from short-term anticipatory behaviours or administrative adjustments occurring around the time of the event. As shown in Table 8, after removing the boundary observations, the absolute values of the estimated treatment effects for comprehensive service fees and treatment fees slightly increase and remain statistically significant, indicating that the results are robust to alternative sample definitions around the threshold.

Polynomial robustness check

To account for potential time-varying confounders such as macroeconomic fluctuations or policy adjustments, we conducted a robustness check by including second- and third-degree polynomial terms of the running variable to flexibly control for nonlinear time trends. Table 9 reports the regression discontinuity estimates for five key outcome variables under alternative polynomial specifications.The results show that, with the exception of treatment fees, the estimated treatment effects (RD coefficients) for total medical costs, comprehensive service fees, diagnostic fees, and pharmaceutical fees remain

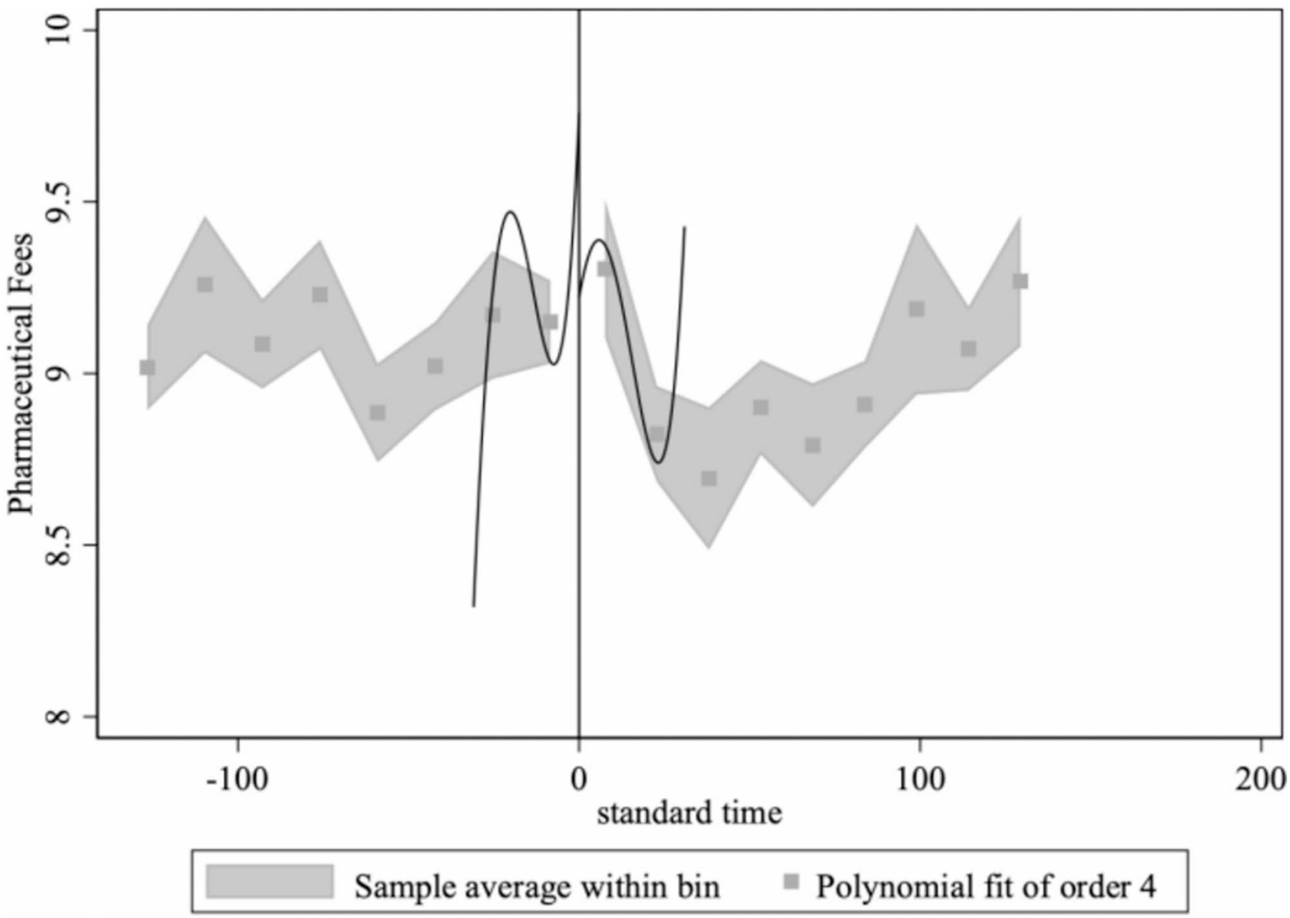

Fig. 5 Polynomial fitting curve for the pharmaceutical fees

Table 2 WPV and medical costs

	(1)	(2)	(3)	(4)	(5)
	Total Medical Costs	**Comprehensive Service Fees**	**Diagnosis Fees**	**Treatment Fees**	**Pharmaceutical Fees**
RD	0.036	0.201***	0.019	-0.902***	-0.039
	(1.023)	(5.045)	(0.366)	(-7.763)	(-0.624)
Control variables	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES
N	5675	5670	5675	5675	5675
BandwiDepartment Transferh	90	90	90	90	90

The values in parentheses represent t-values; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The same applies to the following tables

consistent in direction and statistical significance compared to the baseline model. This indicates strong robustness of the findings to alternative specifications of time trend controls.

However, the RD coefficient for treatment fees loses its significance when second- and third-degree polynomials are introduced. This may be due to overfitting caused by unnecessary model complexity, which fails to improve explanatory power. In most cases, a first-degree polynomial is sufficient to capture local changes at the cutoff. Therefore, the interpretation of the treatment effect on treatment fees is still based on the baseline regression discontinuity model.

BandwiDepartment transferh sensitivity analysis

To assess the robustness of the baseline regression results, this study conducted a ± 20% bandwidth sensitivity analysis on the key parameter in the regression discontinuity (RD) design—the bandwidth selection. Specifically, RD estimates were performed at 80% (h = 72)

Table 3 Defensive medicine and patient outcomes

	Healthcare utilization			Medical process				Patient burden and health outcomes			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Length Of Stay	**Number Of Hospitalizations**	**The 31-day Readmission Rate**	**Department Transfer**	**Surgical Levels**	**Traditional Chinese Medicine Cost**	**Traditional Chinese Medicine Proportion**	**Out-of-pocket Ratio**	**Out-of-pocket Amount**	**Comprehensive Health**	**Primary Health**
RD	0.120***	0.212***	0.005	0.036*	-0.187**	0.504***	0.003**	-0.040*	-0.413***	-0.088**	-0.079*
	(5.376)	(4.626)	(0.181)	(1.805)	(-2.566)	(3.915)	(2.348)	(-1.910)	(-3.125)	(-2.337)	(-1.893)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	5675	5675	5623	5675	5675	3691	5675	5657	2963	5675	5593
BandwiDepartment Transferh	90	90	90	90	90	90	90	90	90	90	90

Model (5) does not include Surgical Levels as a control variable, while Models (10) and (11) do not include Comprehensive Health as a control variable

and 120% (h = 108) of the benchmark bandwidth (h = 90). As shown in Table 10, the positive effect on total medical expenditure and the negative effect on therapeutic expenditure remain statistically significant across alternative bandwidth specifications, indicating strong numerical robustness of the baseline estimates.

Furthermore, Fig. 8 illustrates the RD estimates and their 95% confidence intervals for five key outcome variables under the adjusted bandwidth settings. The black diamond marker represents the estimate obtained at the benchmark bandwidth (h = 90). As can be seen, the estimates for most variables exhibit limited fluctuation and consistent direction across bandwidth choices, further validating the robustness of the findings and the credibility of the identification strategy.

Further analysis

Previous research has found that WPV against healthcare professionals leads to an increase in defensive medical expenditures, as doctors may actively conduct unnecessary medical tests to mitigate the risk of such violence. These include issuing unnecessary lab tests, excessive disease screenings [20], tendencies toward multiple consultations, admitting patients without signs of needing hospitalization, and maintaining more detailed medical records, all of which contribute to an increase in diagnostic fees to varying extents.

However, the previous estimation results indicate that the treatment effect coefficient for diagnostic fees (RD) is not statistically significant under the baseline bandwiDepartment Transferh. To further investigate this phenomenon, this study examines the treatment effect of diagnostic fees under different bandwiDepartment Transferhs, with the results presented in Table 11. When the bandwiDepartment Transferh is set to 30 or 40, the treatment effect coefficient for diagnostic fees (RD) is significantly positive at the 5% level, indicating that, in the early stages of a WPV against healthcare professionals event, the increase in medical costs is closely related to the event. However, as the bandwiDepartment Transferh increases to 50 and 60, the treatment effect coefficient for diagnostic fees (RD) is no longer significant. This suggests that in the later stages following the event, while the trend of increasing medical costs persists, its statistical significance diminishes.

In China, a verification system ensures the rationality and economic efficiency of medical services while preventing over medicalization and waste. The verification system may explain why the significant effect of WPV against healthcare professionals on diagnostic fees exhibits a wave-like diminishing pattern. In the early stages of such an event, the verification system is stricter, leading to a more significant impact on diagnostic fees in the short term. However, over time, verification pressure may

Table 4 Robustness check: exclude the sample during the spring festival period

	(1)	(2)	(3)	(4)	(5)
	Total Medical Costs	**Comprehensive Service Fees**	**Diagnosis Fees**	**Treatment Fees**	**Pharmaceutical Fees**
RD	0.035	0.185***	0.034	-0.802***	-0.035
	(0.988)	(4.637)	(0.656)	(-6.937)	(-0.568)
Control variables	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES
N	5103	5098	5103	5103	5103
BandwiDepartment Transferh	90	90	90	90	90

Table 5 Robustness check: varying the time window

	(1)	(2)	(3)	(4)	(5)
	Total Medical Costs	**Comprehensive Service Fees**	**Diagnosis Fees**	**Treatment Fees**	**Pharmaceutical Fees**
Two-month window					
RD	0.019	0.158***	0.020	-0.759***	-0.058
	(0.508)	(3.695)	(0.317)	(-5.977)	(-0.891)
N	3196	3193	3196	3196	3196
Three-month window					
RD	0.033	0.210***	0.049	-0.854***	-0.040
	(0.957)	(5.159)	(0.812)	(-7.126)	(-0.640)
N	4449	4445	4449	4449	4449
Five-month window					
RD	0.040	0.203***	0.021	-0.898***	-0.031
	(1.142)	(5.112)	(0.406)	(-7.734)	(-0.504)
N	6937	6931	6937	6937	6937
Six-month window					
RD	0.033	0.209***	0.047	-0.869***	-0.041
	(0.947)	(5.071)	(0.781)	(-7.169)	(-0.670)
N	8198	8191	8198	8198	8198
Control variables	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES
BandwiDepartment Transferh	90	90	90	90	90

Table 6 Robustness check: covariate balance test

Variable	**Mean_Pre**	**Mean_Post**	**SMD**	***P*-value**
Payment Method	1.646	1.597	-0.059	0.025
Marriage	0.642	0.624	-0.038	0.151
Comprehensive Health	3.203	3.120	-0.153	0.000
Gender	1.492	1.496	0.008	0.770
Surgical Levels	1.404	1.173	-0.152	0.000
Emergency	0.134	0.121	-0.039	0.140
ACCI	2.673	2.635	-0.015	0.568

weaken, slowing the increase in diagnostic fees and eventually making the effect statistically insignificant.

To further substantiate this, the study conducts a binomial fit on diagnostic fees, with the estimation results presented in Table 12. Regardless of the chosen bandwiDepartment Transferh, the treatment effect coefficient (RD) is significantly positive. Overall, as the bandwiDepartment Transferh increases, the significance gradually diminishes, further showing that the impact of WPV against healthcare professionals on diagnostic fees follows a wave-like diminishing pattern rather than a simple linear relationship.

Conclusion

WPV healthcare professionals severely disrupts the harmonious doctor-patient relationship and represents an urgent issue in the current healthcare sector. This study, using case data from W City, treats the wpv against healthcare professionals event on December 14, 2018, as an exogenous shock and employs a regression discontinuity design to systematically explore the effects of such events on healthcare costs and medical behaviors.The baseline regression results indicate that WPV against healthcare professionals significantly reshapes the structure of healthcare costs, manifested in a sharp increase in comprehensive healthcare services and a decrease in

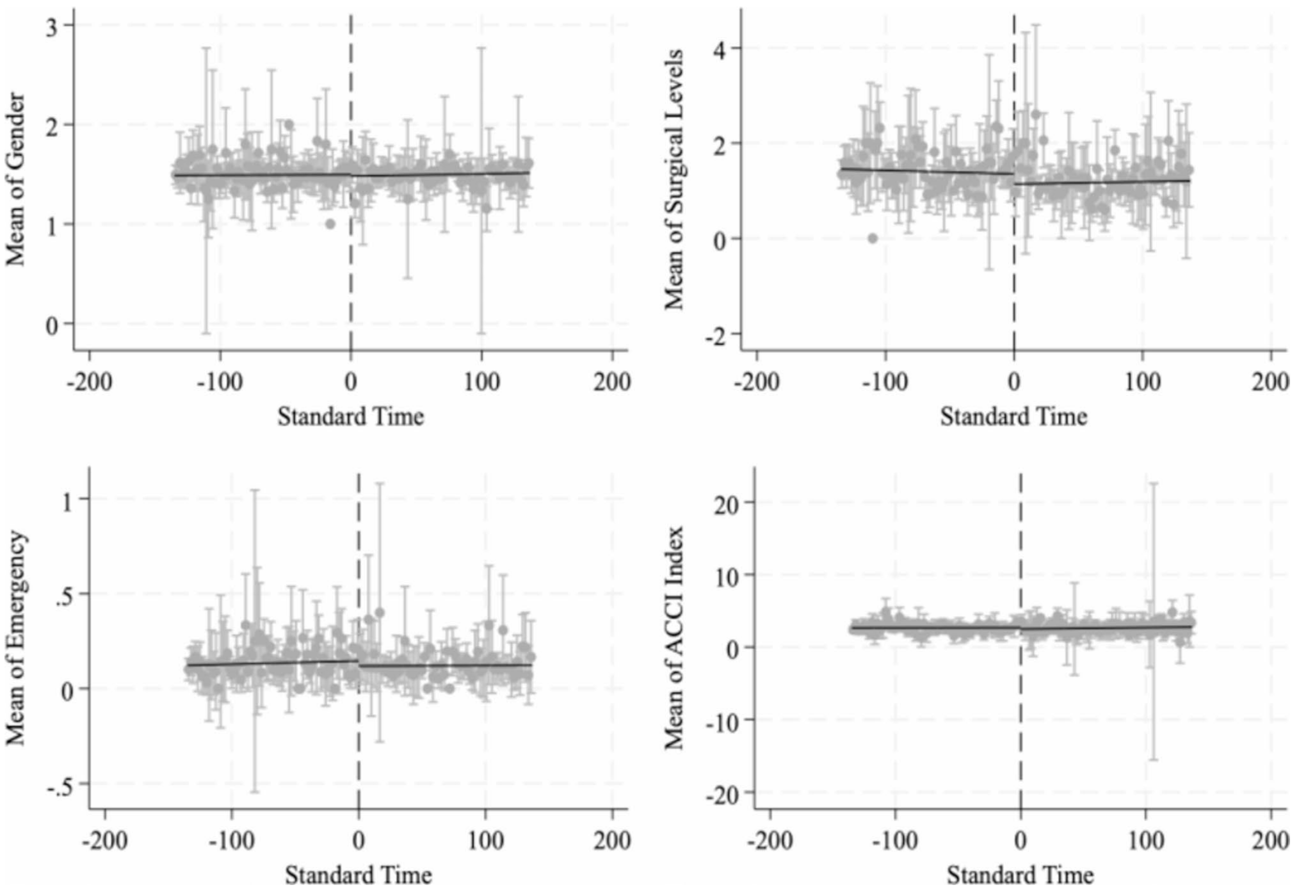

Fig. 6 Parallel regression discontinuity plots for covariates

treatment costs. Further investigation reveals that these events lead to a surge in diagnostic fees in the short term, with the impact following a pattern of gradual attenuation. This may result from healthcare institutions and medical staff adopting preventive measures to mitigate potential violence risks. Examples include increasing hospital security personnel and facilities [30], conducting unnecessary tests to fully "confirm" or "monitor" patient conditions and reduce violence risks [28], and favoring conservative treatment strategies over invasive treatments.

In terms of healthcare utilization and processes, WPV against healthcare professionals extends patients' hospital stays and increases the frequency of interdepartmental transfers, prompting medical decisions to shift toward lower-risk, lower-intensity options. These include reducing surgical levels and increasing the use and cost proportion of TCM—both typical examples of defensive medicine [16]. Notably, from the perspective of defensive medicine actual effects, while these events somewhat alleviate patients' direct financial burden, as reflected in reduced out-of-pocket expenses and co-payment ratios, they cause a significant decline in key health indicators and overall health status at discharge. This decline may stem from low-risk, low-intensity treatment methods failing to effectively improve patients' health and even leading to poorer health outcomes [2, 21].

This phenomenon suggests that, although WPV against healthcare professionals may superficially reduce patients' financial burden, it has negative consequences on health outcomes, highlighting the harm such events inflict on healthcare quality and patient well-being. This finding underscores the profound negative effects of WPV against healthcare professionals on the quality of healthcare services and patient outcomes, emphasizing the urgency of fostering a safe and harmonious doctor-patient relationship and effectively curbing medical violence.

In view of this, measures should be taken to alleviate doctor-patient conflicts and promote the implementation of anti-violence policies to create a harmonious doctor-patient environment. Specifically, prevention and intervention mechanisms for WPV against healthcare professionals should be strengthened, including stricter regulations, enhanced safety management measures, and providing conflict de-escalation training for medical personnel [25]. Baby et al. [44] using data from New Zealand, found that enhancing communication training for

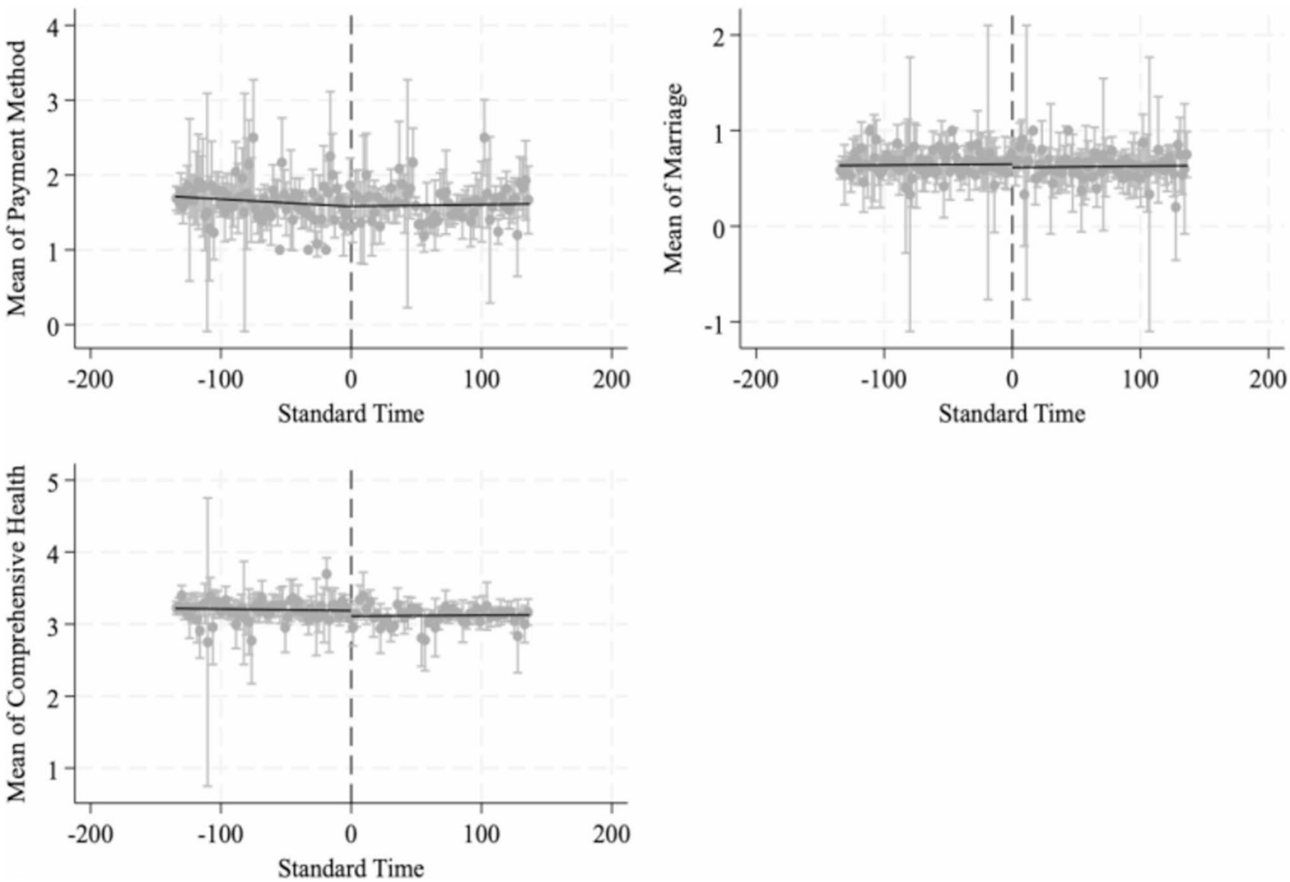

Fig. 7 Parallel regression discontinuity plots for covariates

Table 7 Robustness check: excluding discontinuous covariates

	(1)	(2)	(3)	(4)	(5)
	Total Medical Costs	**Comprehensive Service Fees**	**Diagnosis Fees**	**Treatment Fees**	**Pharmaceutical Fees**
RD	-0.002	0.183***	-0.011	-1.035***	-0.082
	(-0.060)	(4.491)	(-0.219)	(-8.507)	(-1.304)
Control variables	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES
N	5709	5704	5709	5709	5709
BandwiDepartment Transferh	90	90	90	90	90

Table 8 Robustness check: "donut" RD

	(1)	(2)	(3)	(4)	(5)
	Total Medical Costs	**Comprehensive Service Fees**	**Diagnosis Fees**	**Treatment Fees**	**Pharmaceutical Fees**
RD	0.026	0.236***	−0.041	−1.365***	−0.089
	(0.619)	(5.140)	(−0.636)	(−9.747)	(−1.216)
Control variables	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES
N	5481	5476	5481	5481	5481
BandwiDepartment Transferh	90	90	90	90	90

Table 9 Robustness check: polynomial sensitivity

	(1) Total Medical Costs	(2) Comprehensive Service Fees	(3) Diagnosis Fees	(4) Treatment Fees	(5) Pharmaceutical Fees	(6) Total Medical Costs_r ~ 3
RD	0.057	0.163***	0.073	-0.268	0.069	0.299
	(1.113)	(2.731)	(1.019)	(-1.640)	(0.772)	(1.410)
Control variables	YES	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES	YES
N	5675	5670	5675	5675	5675	5675
BandwiDepartment Transferh	90	90	90	90	90	90

Table 10 Robustness check: bandwidepartment transferh sensitivity

	(1) Total Medical Costs	(2) Comprehensive Service Fees	(3) Diagnosis Fees	(4) Treatment Fees	(5) Pharmaceutical Fees
H = 72					
RD	0.043	0.190***	0.033	-0.657***	-0.011
	(1.102)	(4.230)	(0.579)	(-5.062)	(-0.160)
H = 108					
RD	0.034	0.205***	0.013	-1.030***	-0.042
	(1.057)	(5.597)	(0.258)	(-9.548)	(-0.727)
Control variables	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES
N	5675	5670	5675	5675	5675

healthcare staff can effectively reduce conflicts and lower the incidence of violent events.

Furthermore, reforms should be considered for the payment and cost structure of healthcare services, including promoting a patient-centered medical model [45, 46], reducing unnecessary interventions, and lowering the cost burden of defensive medicine while ensuring patient well-being. The unified payment model in the United States and value-based healthcare reforms in Europe link payment systems to treatment outcomes, encouraging healthcare providers to focus on treatment effectiveness rather than service volume [47].

Limitation

This study has several limitations. First, the external validity of the study findings may be limited. Although the WPV incident analysed in this research attracted extensive national attention, our empirical analysis remains confined to data from a single city-level setting. Future studies could enhance the generalisability and explanatory power of the findings by conducting cross-regional comparative analyses, incorporating events with varying levels of media exposure or public salience, and utilising nationally representative administrative healthcare datasets.

Second, residual confounding may persist despite controlling for hospital and patient characteristics. Factors such as managerial quality and socioeconomic status remain incompletely captured. Subsequent studies might employ advanced methodologies like instrumental variable approaches or propensity score matching to address these limitations, alongside exploring longer-term consequences of WPV, including defensive medicine and chronic health impacts to inform comprehensive policy solutions.

Third, while establishing preliminary evidence on cost-effectiveness implications, the analysis leaves critical questions unanswered. Further investigations could explore differential effects across hospital types (e.g., public versus private institutions) and utilise longitudinal data to assess temporal patterns. The incorporation of exogenous shock events might enhance causal inference regarding systemic impacts of healthcare violence.

Fourth, although the robustness checks excluding covariates with visible discontinuities confirmed the stability of the main findings, we acknowledge that the validity of the RDiT design may still be sensitive to the selection and behaviour of covariates. Future research could consider more advanced approaches, such as

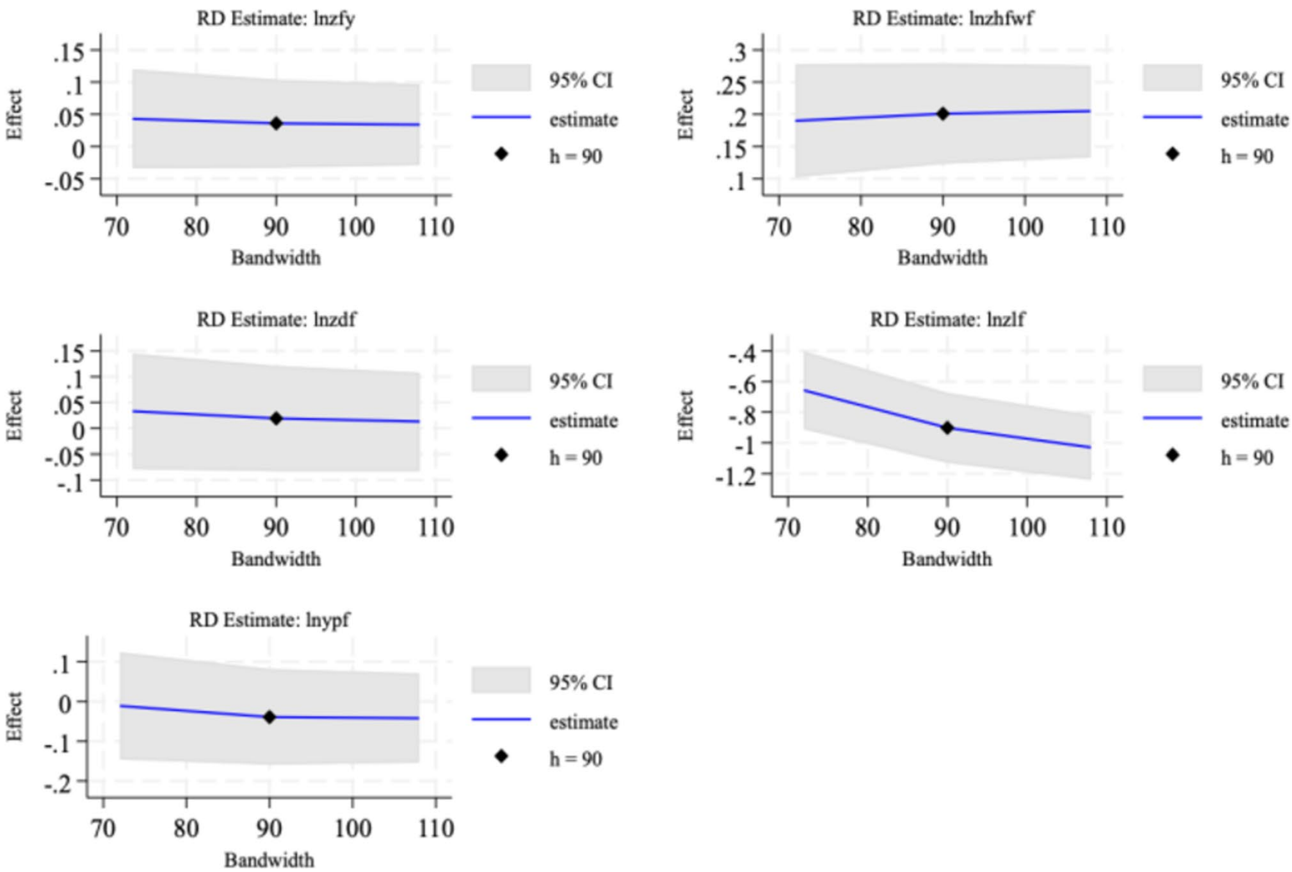

Fig. 8 Trends of regression discontinuity estimates for key outcomes under varying bandwidths

Table 11 Diagnostic fees bandwidepartment transferh sensitivity analysis

	(1)	(2)	(3)	(4)
	Diagnosis Fees	**Diagnosis Fees**	**Diagnosis Fees**	**Diagnosis Fees**
RD	0.149**	0.138**	0.071	0.051
	(2.097)	(1.999)	(1.077)	(0.830)
Control variables	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES
N	5675	5675	5675	5675
BandwiDepartment Transferh	30	40	50	60

Table 12 Binomial fit

	(1)	(2)	(3)	(5)	(4)
	Diagnosis Fees ~ 2	**Diagnosis Fees ~ 2**	**Diagnosis Fees ~ 2**	**Diagnosis Fees ~ 2**	**Diagnosis Fees ~ 2**
RD	0.181**	0.250***	0.182**	0.141*	0.125*
	(1.963)	(2.887)	(2.205)	(1.815)	(1.671)
Control variables	YES	YES	YES	YES	YES
Hospital fixed	YES	YES	YES	YES	YES
Department fixed	YES	YES	YES	YES	YES
Disease type fixed	YES	YES	YES	YES	YES
N	5675	5675	5675	5675	5675
BandwiDepartment Transferh	40	50	60	70	80

covariate-adjusted local randomisation or refined data processing, to further strengthen causal identification.

Finally, although this study constructs multi-dimensional indicators to capture defensive medicine and adjusts for important confounders such as disease severity (ACCI), emergency admission status, and payment methods, these indicators may still embed non-defensive elements. For example, longer hospital stays and department transfers may also reflect case complexity, patient preferences, or institutional practices unrelated to defensive intent. Future research could leverage micro-level data such as physician behavior logs, clinical pathway audits, or in-depth interviews to better disentangle defensive motivations from other explanatory factors, thereby improving construct validity.

Financial disclosure
No financial disclosures were reported by the authors of this paper.

Authors' contributions
Guoheng Hu and Haining Zhao designed the study. Guoheng Hu and Haining Zhao organized the data, designed and developed the database. Haining Zhao and Ying Li conducted the data analysis and wrote the initial draft of the manuscript. All authors have read and approved the final submitted manuscript.

Funding
This work has been supported by the Hebei Provincial Natural Science Foundation Youth Project (G2023203015).

Data availability
The data used in this study are confidential and cannot be publicly shared. Academic researchers interested in accessing these datasets for further research are encouraged to contact the corresponding author to discuss potential data access.

Declarations

Ethics approval and consent to participate
This study is based on administrative data from the medical insurance settlement platform of H Province, China. All data were fully anonymized and de-identified before being accessed by researchers, ensuring that no personally identifiable information was included. According to the relevant provisions of the "Personal Information Protection Law of the People's Republic of China", the "Data Security Law of the People's Republic of China", and the "Ethical Review Measures for Biomedical Research Involving Human Subjects", research using anonymized administrative data does not involve the direct recruitment of human participants and therefore does not require ethical approval or informed consent. Furthermore, this study complies with the principles of the "Declaration of Helsinki".

Competing interests
The authors declare no competing interests.

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Received: 21 March 2025 / Accepted: 21 May 2025
Published online: 30 May 2025

References

1. Taylor JL, Rew L. A systematic review of the literature: workplace violence in the emergency department. J Clin Nurs. 2011;20(7–8):1072–85. https://doi.org/10.1111/j.1365-2702.2010.03342.x. Epub 2010 Sep 15. Payment MethodID: 20846214.
2. Caruso R, Toffanin T, Folesani F, Biancosino B, Romagnolo F, Riba MB, McFarland D, Palagini L, Belvederi Murri M, Zerbinati L, Grassi L. Violence against physicians in the workplace: trends, causes, consequences, and strategies for intervention. Curr Psychiatry Rep. 2022;24(12):911–24. https://doi.org/10.1007/s11920-022-01398-1. Epub 2022 Nov 29. Payment MethodID: 36445636; Payment MethodCID: Payment MethodC9707179.
3. McKay D, Heisler M, Mishori R, Catton H, Kloiber O. Attacks against health-care personnel must stop, especially as the world fights COVID-19. Lancet. 2020;395(10239):1743–1745. https://doi.org/10.1016/S0140-6736(20)31191-0. Epub 2020 May 20. Payment MethodID: 32445692; Payment MethodCID: Payment MethodC7239629.
4. Campbell JC, Messing JT, Kub J, Agnew J, Fitzgerald S, Fowler B, Sheridan D, Lindauer C, Deaton J, Bolyard R. Workplace violence: prevalence and risk factors in the safe at work study. J Occup Environ Med. 2011;53(1):82–9. https://doi.org/10.1097/JOM.0b013e3182028d55. Payment MethodID: 21187791.
5. ChaPayment Methodan R, Styles I. An epidemic of abuse and violence: nurse on the front line. Accid Emerg Nurs. 2006;14(4):245–9. https://doi.org/10.1016/j.aaen.2006.08.004. Epub 2006 Oct 24. Payment MethodID: 17064902.
6. Fujita S, Ito S, Seto K, Kitazawa T, Matsumoto K, Hasegawa T. Risk factors of workplace violence at hospitals in Japan. J Hosp Med. 2012;7(2):79–84. https://doi.org/10.1002/jhm.976. Epub 2011 Nov 4. Payment MethodID: 22058040.
7. Darawad MW, Al-Hussami M, Saleh AM, Mustafa WM, Odeh H. Violence against nurses in emergency departments in Jordan: nurses' perspective. Workplace Health Saf. 2015;63(1):9–17. doi: 10.1177/2165079914565348. Payment MethodID: 25791406.
8. Algwaiz WM, Alghanim SA. Violence exposure among health care professionals in Saudi public hospitals. A preliminary investigation. Saudi Med J. 2012;33(1):76–82. Payment MethodID: 22273653.
9. Talas MS, Kocaöz S, Akgüç S. A survey of violence against staff working in the emergency department in ankara, Turkey. Asian Nurs Res (Korean Soc Nurs Sci). 2011;5(4):197–203. https://doi.org/10.1016/j.anr.2011.11.001. Epub 2011 Nov 24. Payment MethodID: 25030520.
10. Wu S, Zhu W, Li H, Lin S, Chai W, Wang X. Workplace violence and influencing factors among medical professionals in China. Am J Ind Med. 2012;55(11):1000–8. https://doi.org/10.1002/ajim.22097. Epub 2012 Aug 6. Payment MethodID: 22886819.
11. Fute M, Mengesha ZB, Wakgari N, Tessema GA. High prevalence of workplace violence among nurses working at public health facilities in Southern Ethiopia. BMC Nurs. 2015;14:9. https://doi.org/10.1186/s12912-015-0062-1. Payment MethodID: 25767412; Payment MethodCID: Payment MethodC4357058.
12. Elliott PP. Violence in health care. What nurse managers need to know. Nurs Manage. 1997;28(12):38–41; quiz 42. Payment MethodID: 9423452.
13. Hokee MY, Makkink AW, Vincent-Lambert C. Workplace violence against paramedic personnel: a protocol for a scoping review. BMJ Open. 2023;13(1):e067246. https://doi.org/10.1136/bmjopen-2022-067246. Payment MethodID: 36639208; Payment MethodCID: Payment MethodC9843223.
14. Ghareeb NS, El-Shafei DA, Eladl AM. Workplace violence among healthcare workers during COVID-19 pandemic in a Jordanian governmental hospital: the tip of the iceberg. Environ Sci Pollut Res Int. 2021;28(43):61441–9. https://doi.org/10.1007/s11356-021-15112-w. Epub 2021 Jun 26. Payment MethodID : 34173953; Payment MethodCID: Payment MethodC8233595.
15. Alhamad R, Suleiman A, Bsisu I, Santarisi A, Al Owaidat A, Sabri A, Farraj M, Al Omar M, Almazaydeh R, Odeh G, Al Mousa M, Mahseeri M. Violence against physicians in Jordan: An analytical cross-sectional study. PLoS One. 2021;16(1):e0245192. https://doi.org/10.1371/journal.pone.0245192. Payment MethodID: 33493170; Payment MethodCID: Payment MethodC7833172.
16. Catino M. Blame culture and defensive medicine. Cognit Technol Work. 2009;11(4):245–253. https://doi.org/10.1007/s10111-009-0130-y.
17. Garcia-Retamero R, Galesic M. On defensive decision making: how Doctors make decisions for their patients. Health Expect. 2014;17(5):664–9. https://doi.org/10.1111/j.1369-7625.2012.00791.x. Epub 2012 May 31. Payment MethodID: 22646919; Payment MethodCID: Payment MethodC5060905.
18. Sloan FA, Shadle JH. Is there empirical evidence for defensive medicine?? A reassessment. J Health Econ. 2009;28(2):481–91. https://doi.org/10.1016/j.jhealeco.2008.12.006. Epub 2008 Dec 25. PMID: 19201500.

19. Frakes M, Gruber J. Defensive medicine: evidence from military immunity. Am Econ J Econ Policy. 2019;11(3):197–231. doi: 10.1257/pol.20180167. Payment MethodID: 31632594; Payment MethodCID: Payment MethodC6800742.
20. Kanzaria HK, Hoffman JR, Probst MA, Caloyeras JP, Berry SH, Brook RH. Emergency physician perceptions of medically unnecessary advanced diagnostic imaging. Acad Emerg Med. 2015;22(4):390–8. https://doi.org/10.1111/acem.12625. Epub 2015 Mar 23. PMID: 25807868.
21. Baicker K, Wright BJ, Olson NA. Reevaluating reports of defensive medicine. J Health Polit Policy Law. 2015;40(6):1157–77. https://doi.org/10.1215/03616878-3424462. Epub 2015 Oct 7. PMID: 26447025.
22. Andersen MK, Hvidt EA, Pedersen KM, Lykkegaard J, Waldorff FB, Munck AP, Pedersen LB. Defensive medicine in Danish general practice. Types of defensive actions and reasons for practicing defensively. Scand J Prim Health Care. 2021;39(4):413–8. Epub 2021 Aug 31. PMID: 34463601; PMCID: PMC8725848.
23. O'Brien CJ, van Zundert AAJ, Barach PR. The growing burden of workplace workplace violence against healthcare professionals: trends in prevalence, risk factors, consequences, and prevention - a narrative review. EClinicalMedicine. 2024;72:102641. https://doi.org/10.1016/j.eclinm.2024.102641. PMID: 38840669; PMCID: PMC11152903.
24. Guo L, Ryan B, Leditschke IA, Haines KJ, Cook K, Eriksson L, Olusanya O, Selak T, Shekar K, Ramanan M. Impact of unacceptable behaviour between healthcare workers on clinical performance and patient outcomes: a systematic review. BMJ Qual Saf. 2022;31(9):679–87. https://doi.org/10.1136/bmjqs-2021-013955. Epub 2022 Jan 19. PMID: 35046101.
25. Aljohani B, Burkholder J, Tran QK, Chen C, Beisenova K, Pourmand A. Workplace violence in the emergency department: a systematic review and meta-analysis. Public Health. 2021;196:186–97. https://doi.org/10.1016/j.puhe.2021.02.009. Epub 2021 Jul 8. Payment MethodID: 34246105.
26. O'Brien CJ, van Zundert AAJ, Barach PR. The growing burden of workplace workplace violence against healthcare professionals: trends in prevalence, risk factors, consequences, and prevention a narrative review. EClinicalMedicine. 2024;72:102641. https://doi.org/10.1016/j.eclinm.2024.102641. Payment MethodID: 38840669; Payment MethodCID: Payment MethodC11152903.
27. Reschovsky JD, Saiontz-Martinez CB. Malpractice claim fears and the costs of treating medicare patients: A new approach to estimating the costs of defensive medicine. Health Serv Res. 2018;53(3):1498–516. https://doi.org/10.1111/1475-6773.12660. Epub 2017 Jan 26. Payment MethodID: 28127752; Payment MethodCID: Payment MethodC5980310.
28. Dyrbye LN, West CP, Sinsky CA, Trockel M, Tutty M, Satele D, Carlasare L, Shanafelt T. Physicians' Experiences With Mistreatment and Discrimination by Patients, Families, and Visitors and Association With Burnout. JAMA Netw Open. 2022;5(5):e2213080. https://doi.org/10.1001/jamanetworkopen.2022.13080. Payment MethodID: 35587344; Payment MethodCID: Payment MethodC9121189.
29. Odes R, Chapman S, Harrison R, Ackerman S, Hong O. Frequency of violence towards healthcare workers in the United States' inpatient psychiatric hospitals: A systematic review of literature. Int J Ment Health Nurs. 2021;30(1):27–46. https://doi.org/10.1111/inm.12812. Epub 2020 Nov 4. PMID: 33150644.
30. Grossman DC, Choucair B, Violence, And The US Health Care Sector.: Burden-Response. Health Aff (Millwood). 2019;38(10):1638–1645. https://doi.org/10.1377/hlthaff.2019.00642. Payment MethodID: 31589530.
31. Raposo VL. Defensive Medicine and the Imposition of a More Demanding Standard of Care. J Leg Med. 2019;39(4):401–416. https://doi.org/10.1080/01947648.2019.1677273. PMID: 31940251.
32. Khan MN, Haq ZU, Khan M, Wali S, Baddia F, Rasul S, Khan S, Polkowski M, Ramirez-Mendoza JY. Prevalence and determinants of violence against health care in the metropolitan city of Peshawar: a cross sectional study. BMC Public Health. 2021;21(1):330. https://doi.org/10.1186/s12889-021-10243-8. PMID: 33568108; PMCID: PMC7877048.
33. Chakraborty S, Mashreky SR, Dalal K. Violence against physicians and nurses: a systematic literature review. Z Gesundh Wiss. 2022;30(8):1837–55. https://doi.org/10.1007/s10389-021-01689-6. Epub 2022 Jan 22. PMID: 35096514; PMCID: PMC8783572.
34. Pearson CM, Porath CL. On the nature, consequences and remedies of workplace incivility: no time for nice? Think again. Acad Manage Perspect. 2005;19:7–18. https://doi.org/10.5465/AME.2005.15841946.
35. Liu J, Zheng J, Liu K, Liu X, Wu Y, Wang J, You L. Workplace violence against nurses, job satisfaction, burnout, and patient safety in Chinese hospitals. Nurs Outlook. 2019;67(5):558–566. https://doi.org/10.1016/j.outlook.2019.04.006. Epub 2019 May 2. PMID: 31202444.
36. George, Loewenstein, Samuel, et al. Source dependence in the valuation of objects. J Behavioral Decision Making. 1994;7(3):157–68. https://doi.org/10.1002/bdm.3960070302.
37. Caruso R, Toffanin T, Folesani F, Biancosino B, Romagnolo F, Riba MB, McFarland D, Palagini L, Belvederi Murri M, Zerbinati L, Grassi L. Violence against physicians in the workplace: trends, causes, consequences, and strategies for intervention. Curr Psychiatry Rep. 2022;24(12):911–24. Epub 2022 Nov 29. PMID: 36445636; PMCID: PMC9707179.
38. Dubay L, Kaestne R, Waidmann T. Medical malpractice liability and its effect on prenatal care utilization and infant health. J Health Econ. 2001;20(4):591–611. https://doi.org/10.1016/s0167-6296(01)00082-0. PMID: 11463190.
39. Lakdawalla DN, Seabury SA. The welfare effects of medical malpractice liability. Int Rev Law Econ. 2012;32(4):356–69. https://doi.org/10.1016/j.irle.2012.07.003. PMID: 23526860; PMCID: PMC3601788.
40. Klick J, Stratmann T. Medical malpractice reform and physicians in High-Risk specialties. J Legal Stud. 2007;36. https://doi.org/10.1086/520416.
41. Reuveni I, Pelov I, Reuveni H, Bonne O, Canetti L. Cross-sectional survey on defensive practices and defensive behaviours among Israeli psychiatrists. BMJ Open. 2017;7(3):e014153. https://doi.org/10.1136/bmjopen-2016-014153. PMID: 28320795; PMCID: PMC5372095.
42. Jena AB, Chandra A, Lakdawalla D, Seabury S. Outcomes of medical malpractice litigation against US physicians. Arch Intern Med. 2012;172(11):892-4. https://doi.org/10.1001/archinternmed.2012.1416. PMID: 22825616.
43. Barreca AI, Guldi M, Lindo JM, Waddell GR. Saving babies? Revisiting the effect of very low birth weight classification. Q J Econ. 2011;126(4):2117–1223. https://doi.org/10.1093/qje/qjr042.
44. Baby M, Gale C, Swain N. A communication skills intervention to minimise patient perpetrated aggression for healthcare support workers in new Zealand: A cluster randomised controlled trial. Health Soc Care Community. 2019;27(1):170–81. https://doi.org/10.1111/hsc.12636. Epub 2018 Sep 2. Pay ment MethodID: 30175538.
45. Natan MB. Patient-Centered Care in Healthcare and its Implementation in Nursing. 2017.
46. Lutz BJ, Bowers BJ. Patient-centered care: Understanding its interpretation and implementation in health care. Sch Inq Nurs Pract. 2000;14(2):165–83. discussion 183-7. Payment MethodID: 10983489.
47. Iorio R. Strategies and tactics for successful implementation of bundled payments: bundled payment for care improvement at a large, urban, academic medical center. J Arthroplasty. 2015;30(3):349–50. https://doi.org/10.1016/j.arth.2014.12.031. Epub 2015 Jan 23. Payment MethodID: 25680447.

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