Postoperative adverse outcomes among physicians receiving major surgeries
A nationwide retrospective cohort study

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Abstract

Outcomes after surgeries involving physicians as patients have not been researched. This study compares postoperative adverse events between physicians as surgical patients and nonhealth professional controls.

Using reimbursement claims data from Taiwan's National Health Insurance Program, we conducted a matched retrospective cohort study of 7973 physicians as surgical patients and 7973 propensity score–matched nonphysician controls receiving in-hospital major surgeries between 2004 and 2010. We compared postoperative major complications, length of hospital stay, intensive care unit (ICU), medical expenditure, and 30-day mortality.

Compared with nonphysician controls, physicians as surgical patients had lower adjusted odds ratios (ORs) with 95% confidence intervals (CIs) of postoperative deep wound infection (OR 0.63, 95% CI 0.40–0.99; $P < 0.05$), prolonged length of stay (OR 0.68, 95% CI 0.62–0.75; $P < 0.0001$), ICU admission (OR 0.74, 95% CI 0.66–0.83; $P < 0.0001$), and increased medical expenditure (OR 0.80, 95% CI 0.73–0.88; $P < 0.0001$). Physicians as surgical patients were not associated with 30-day in-hospital mortality after surgery. Physicians working at medical centers ($P < 0.05$ for all), dentists ($P < 0.05$ for all), and those with fewer coexisting medical conditions ($P < 0.05$ for all) had lower risks for postoperative prolonged length of stay, ICU admission, and increased medical expenditure.

Although our study's findings suggest that physicians as surgical patients have better outcomes after surgery, future clinical prospective studies are needed for validation.

Abbreviations: CI = confidence interval, ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification, OR = odds ratio.

Keywords: adverse outcomes, cohort, physicians, surgery

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1. Introduction

With 234 million major surgeries performed worldwide each year,[1] adverse events after surgery remain a critical health issue. These adverse events account for approximately 11% of globally lost health-years, totaling more than 161 million years between 1999 and 2002.[2] Perioperative complications, mortality, and increased medical resource use are usually considered as the main adverse outcomes after surgery.[3] To investigate such perioperative adverse events, previous studies mainly focused on the influences of patient sociodemographics, lifestyles, and coexisting medical conditions, as well as on types of surgery and anesthesia, surgeons' experience and skills, and hospital characteristics.[4–10]

Since the psychiatric problems of physicians were reported in 1964,[11] issues surrounding physicians' health and medical care have been the subject of many studies. Cancer,[12] outcomes after pregnancy,[13] substance abuse,[14] infectious disease,[15] injury,[16] suicide,[17] hospitalizations,[18] and overall mortality[19] among physicians have been investigated in diverse settings, but these findings were often controversial and were limited to specific diseases and often controversial.

We found no information available on perioperative outcomes for physicians as surgical patients; whether physicians have better or worse outcomes after surgeries was unknown. Using the reimbursement claims from Taiwan's National Health Insurance program, we conducted a nationwide matched cohort study to compare postoperative adverse events between physicians as surgical patients and nonphysician controls.

2. Methods

2.1. Data sources

Research data were obtained from reimbursement claims of the National Health Insurance program, which was implemented in March 1995 and covers more than 99% of Taiwan's 22.6 million residents. The National Health Research Institutes established a National Health Insurance Research Database that records all beneficiaries' medical services, including inpatient and outpatient demographics, primary and secondary diagnoses, procedures, prescriptions, and medical expenditures. The research articles based on this database have been accepted in prominent scientific journals worldwide.[20,21]

2.2. Ethical approval

Insurance reimbursement claims from this National Health Insurance Research Database are available for public access. To protect personal privacy, the electronic database with patient identifications was decoded and scrambled for further research access. Although informed consent was not required because of this privacy protection, the study was evaluated and approved by Taiwan's National Health Research Institutes (NHIRD-103-121) and the Joint Institutional Review Board of Taipei Medical University (201404070 and 201504008).[20,21]

2.3. Study design

We examined medical claims and identified 7973 physicians aged 20 years and older with registered licenses (including physicians of Western medicine, dentists, and traditional Chinese medicine [TCM] practitioners) as surgical patients from 3177,239 patients who underwent inpatient surgeries in Taiwan between 2004 and 2010. These surgeries required hospitalization for more than 1 day and general, epidural, or spinal anesthesia. We matched each physician as a surgical patient with a nonphysician surgical patient by sex, age, type of surgery and anesthesia, coexisting medical conditions, and operation in teaching hospital or not. We conducted the analysis with a propensity score–matched pair procedure.

2.4. Measurements and definitions

Nonphysician controls were defined as people without occupation in health-related fields. This excludes medical doctors, pharmacists, nurses, physical and occupational therapists, dietitians, and other clinical workers. We identified income status by defining low-income patients as those qualified for waived medical copayment, as this is verified by the Taiwan Bureau of National Health Insurance.[20,21] Low-income patients were excluded from this study. Whether the surgery was performed in teaching hospital or not and the types of surgery and anesthesia were also recorded. We used *the International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) to define preoperative medical diseases and postoperative complications. Coexisting medical conditions were determined by the principal and secondary diagnoses from medical claims for the 24-month preoperative period including hypertension (ICD-9-CM 401–405), mental disorders (ICD-9-CM 290–319), chronic obstructive pulmonary disease (ICD-9-CM 490–496), diabetes (ICD-9-CM 250), ischemic heart disease (ICD-9-CM 410–414), hyperlipidemia (ICD-9-CM 272.0–272.2), stroke (ICD-9-CM 430–438), and liver cirrhosis (ICD-9-CM 571). Renal dialysis included peritoneal and hemodi-

alysis, which were defined by administration codes (D8 and D9). In-hospital 30-day mortality after the index surgery was considered the study's primary outcome. Admission to intensive care unit (ICU), prolonged length of stay, increased medical expenditure, and 7 major surgical postoperative complications were analyzed as secondary outcomes, including septicemia (ICD-9-CM 038 and 998.5), pneumonia (ICD-9-CM 480–486), stroke (ICD-9-CM 430–438), acute renal failure (ICD-9-CM 584), deep wound infection (ICD-9-CM 958.3), pulmonary embolism (ICD-9-CM 415), and acute myocardial infarction (ICD-9-CM 410) after index surgery.[20,21] Physicians were categorized as licensed physicians in TCM; physicians in family medicine, pulmonary medicine, psychiatry, gastroenterology, cardiology, neurology, nephrology, dermatology, radiology, nuclear medicine, physical medicine, and rehabilitation; surgery-related physicians (such as those working in surgery, obstetrics, gynecology, anesthesiology, and emergency medicine); and dentists. Medical facilities were categorized into clinics, hospitals, and medical centers. The Charlson Comorbidity Index was also identified as one of the covariates in this study.

2.5. Statistical analysis

To reduce confounding bias, we developed a nonparsimonious multivariable logistic regression model to estimate a propensity score for physician status, irrespective of outcome. Clinical significance guided the initial choice of covariates in this model: sex, age, types of surgery and anesthesia, operation in a teaching hospital or not, hypertension, mental disorders, chronic obstructive pulmonary disease, diabetes, ischemic heart disease, hyperlipidemia, stroke, liver cirrhosis, and renal dialysis. In line with statistical research on the development of propensity scores, we used a structured iterative approach to refine this model with the goal of achieving covariate balance within the matched pairs. The chi-square tests were used to measure covariate balance and a P value <0.05 was suggested to represent meaningful covariate imbalance. We matched physician patients to nonphysician patients using a greedy matching algorithm with a calliper width of 0.2 standard deviation of the log odds of the estimated propensity score.

Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for 30-day postoperative complications and mortality between physicians as surgical patients and nonphysician controls were analyzed with multivariate logistic regression by controlling for sex, age, operation in a teaching hospital or not, preoperative coexisting medical conditions, the Charlson Comorbidity Index, and types of surgery and anesthesia. Further analysis assessed whether physicians using traditional Chinese medicine, medical physicians, surgery-related physicians, and dentists were associated with postoperative adverse events by multivariate logistic regression with adjustment. We performed stratification analysis to investigate associations to determine whether physicians had better outcomes after surgery than nonphysician controls compared by age, sex, coexisting medical conditions, and preoperative hospitalization. SAS version 9.1 (SAS Institute Inc., Cary, NC) statistical software was used for data analyses; 2-sided $P < 0.05$ indicated significant differences between groups.

3. Results

Table 1 shows the demographic characteristics of physicians as surgical patients and nonphysician controls receiving inpatient major surgeries. After propensity score matching, there were no significant differences in age ($P = 1.00$), sex ($P = 0.88$), operation

Table 1

Characteristics of physician surgical patients and nonhealth worker control.

	NHW (n = 7973)		Physicians (n = 7973)		P
Sex	n	(%)	n	(%)	0.88
Female	2379	(29.8)	2370	(29.7)	
Male	5594	(70.2)	5603	(70.3)	
Age, y					1.00
20–29	1045	(13.1)	1043	(13.1)	
30–39	1883	(23.6)	1889	(23.7)	
40–49	1585	(19.9)	1587	(19.9)	
50–59	1303	(16.3)	1295	(16.2)	
60–69	774	(9.7)	771	(9.7)	
≥70	1383	(17.4)	1388	(17.4)	
Types of surgery					1.00
Digestive	2267	(28.4)	2271	(28.5)	
Musculoskeletal	1351	(16.9)	1358	(17.0)	
Delivery, CS, and abortion	986	(12.4)	982	(12.3)	
Neurosurgery	632	(7.9)	624	(7.8)	
Kidney, ureter, and bladder	592	(7.4)	584	(7.3)	
Respiratory	449	(5.6)	453	(5.7)	
Cardiovascular	279	(3.5)	279	(3.5)	
Eye	104	(1.3)	106	(1.3)	
Skin	95	(1.2)	99	(1.2)	
Breast	100	(1.3)	99	(1.2)	
Others	1118	(14.0)	1118	(14.0)	
Types of anesthesia					1.00
General	5335	(66.9)	5335	(66.9)	
Epidural or spinal	2638	(33.1)	2638	(33.1)	
Operation in teaching hospital					0.87
No	529	(6.6)	534	(6.7)	
Yes	7444	(93.4)	7439	(93.3)	
Urbanization					0.99
Low	1277	(16.0)	1273	(16.0)	
Moderate	1957	(24.6)	1967	(24.7)	
High	1899	(23.8)	1891	(23.7)	
Very high	2840	(35.6)	2842	(35.7)	
Coexisting medical conditions					
Hypertension	1537	(19.3)	1546	(19.4)	0.86
Mental disorders	981	(12.3)	989	(12.4)	0.85
COPD	640	(8.0)	649	(8.1)	0.79
Diabetes	641	(8.0)	645	(8.1)	0.91
Ischemic heart disease	585	(7.3)	594	(7.5)	0.79
Hyperlipidemia	540	(6.8)	556	(7.0)	0.62
Stroke	210	(2.6)	213	(2.7)	0.88
Liver cirrhosis	106	(1.3)	120	(1.5)	0.35
Renal dialysis	109	(1.4)	109	(1.4)	1.00
CCI scores					0.16
0	4010	(50.3)	3923	(49.2)	
1–2	2815	(35.3)	2926	(36.7)	
3–4	741	(9.3)	749	(9.4)	
≥5	407	(5.1)	375	(4.7)	
Mean ± SD	1.2 ± 1.9		1.2 ± 1.8		0.76

CCI = Charlson Comorbidity Index, COPD = chronic obstructive pulmonary disease, CS = cesarean section, NHW = nonhealth worker, SD = standard deviation.

in teaching hospital ($P = 0.87$), urbanization ($P = 0.99$), hypertension ($P = 0.86$), mental disorders ($P = 0.85$), chronic obstructive pulmonary disease ($P = 0.79$), diabetes ($P = 0.91$), ischemic heart disease ($P = 0.79$), hyperlipidemia ($P = 0.62$), stroke ($P = 0.88$), liver cirrhosis ($P = 0.35$), renal dialysis ($P = 1.00$), Charlson Comorbidity Index ($P = 0.16$), types of surgery ($P = 1.00$), or types of anesthesia ($P = 1.00$) between physicians as surgical patients and nonphysician controls. Compared with nonphysician controls (Table 2), physicians as surgical patients had lower risks of postoperative deep wound infection (OR 0.63, 95% CI 0.40–0.99; $P < 0.05$), ICU admission (OR 0.74, 95% CI 0.66–0.83; $P < 0.0001$), prolonged length of hospital stay (OR 0.68, 95% CI 0.62–0.75; $P < 0.0001$), and increased medical expenditure (OR 0.80, 95% CI 0.73–0.88; $P < 0.0001$). Physicians as surgical patients were not associated with postoperative pneumonia, stroke, postoperative bleeding, acute myocardial infarction, pulmonary embolism, and 30-day in-hospital mortality.

In the stratified analysis (Table 3), decreased risks of prolonged length of stay, ICU admission, and increased medical expenditure were associated with physicians as surgical patients who were males, 20–29, 30–39, or 40–49 years of age. Other risk groups

Table 2

Risk of postoperative adverse events between physician surgical patients and nonhealth worker control in the multiple logistic regressions.

	NHW patients, %	Physician patients, %	OR (95% CI)[*]
Complications after surgery			
Septicemia	4.0	3.5	0.83 (0.74–1.04)
Pneumonia	2.0	2.1	0.84 (0.67–1.06)
Stroke	1.2	1.2	1.00 (0.77–1.31)
Postoperative bleeding	0.8	0.8	1.25 (0.86–1.82)
AMI	0.4	0.4	1.14 (0.68–1.91)
Deep wound infection	0.7	0.4	0.63 (0.40–0.99)[†]
Pulmonary embolism	0.1	0.1	1.99 (0.59–6.66)
Any of the above	8.0	7.4	0.82 (0.74–0.91)[†]
30-d in-hospital mortality	0.7	0.6	1.09 (0.72–1.67)
ICU stay	12.6	10.7	0.74 (0.66–0.83)[‡]
Prolonged length of stay	22.0	17.7	0.68 (0.62–0.75)
Increased ME	21.2	18.8	0.80 (0.73–0.88)[‡]

AMI = acute myocardial infarction, CI = confidence interval, ICU = intensive care unit, ME = medical expenditure, NHW = nonhealth worker, OR = odds ratio.

[*] Adjusted for age, sex, teaching hospital, urbanization, coexisting medical conditions, Charlson Comorbidity Index, types of surgery, and types of anesthesia.

[†] $P < 0.05$.

[‡] $P < 0.0001$.

were those with no medical conditions or 1 medical condition, and those without preoperative hospitalization. Only male physicians (OR 0.52, 95% CI 0.31–0.89; $P < 0.0001$) had lower risk of postoperative deep wound infection compared with control. The decreased risks of prolonged length of stay and increased medical expenditure were also associated with 50–59 years of age and physicians with 1 medical condition. Female physicians as surgical patients had lower risk of increased medical expenditure compared with female nonphysician controls (OR 0.75, 95% CI 0.58–0.97;

$P < 0.05$). Among surgical patients with preoperative hospitalization, physicians as surgical patients had decreased risk of prolonged length of stay (OR 0.82, 95% CI 0.70–0.96; $P < 0.05$). The association between deep wound infection and physicians as surgical patients was not significant in female and in every age group, number of medical conditions, and preoperative hospitalization or not.

Compared with nonphysician controls, physicians of internal medicine (Table 4), surgical-related physicians, and dentists had lower risks of postoperative prolonged stay, ICU admission, and increased medical expenditure. Physicians as surgical patients working at medical centers showed lower risks for postoperative prolonged stay, ICU admission, and increased medical expenditure, with ORs of 0.46 (95% CI 0.33–0.66; $P < 0.0001$), 0.56 (95% CI 0.36–0.88; $P < 0.0001$), and 0.66 (95% CI 0.47–0.93; $P < 0.05$), respectively.

Among surgical patients with no coexisting medical conditions, physicians had lower risk of postoperative deep wound infection (OR 0.55, 95% CI 0.31–0.97; $P < 0.05$), prolonged length of stay (OR 0.64, 95% CI 0.57–0.73; $P < 0.0001$), ICU stay (OR 0.58, 95% CI 0.50–0.69; $P < 0.0001$), and increased medical expenditure (OR 0.74, 95% CI 0.66–0.84; $P < 0.0001$) compared with nonphysician controls. Among surgical patients without hospitalization within 24 months preoperatively, the risk of postoperative deep wound infection (OR 0.56, 95% CI 0.34–0.92; $P < 0.05$), prolonged length of stay (OR 0.59, 95% CI 0.53–0.65; $P < 0.0001$), ICU admission (OR 0.63, 95% CI 0.55–0.72; $P < 0.0001$), and increased medical expenditure (OR 0.71, 95% CI 0.64–0.79; $P < 0.0001$) were lower in physicians than in nonphysician controls.

4. Discussion

This nationwide propensity score–matched retrospective cohort study is among the first to report that physicians as surgical patients had less postoperative deep wound infection, shorter hospital stays, less admission to ICUs, and lower medical

Table 3

Stratification analysis by age and sex for postoperative adverse events between physician surgical patients and nonhealth worker control.

		Deep wound infection		Prolonged length of stay		ICU stay		Increased ME	
	n	Events	OR (95% CI)	Events	OR (95% CI)	Events	OR (95% CI)	Events	OR (95% CI)
Sex[*]									
Female	4749	20	1.24 (0.49–3.14)	375	0.81 (0.64–1.01)	141	0.73 (0.50–1.06)	340	0.75 (0.58–0.97)[†]
Male	11,197	66	0.52 (0.31–0.89)[‡]	2788	0.66 (0.59–0.73)[‡]	1713	0.74 (0.66–0.84)[‡]	2849	0.80 (0.72–0.89)[‡]
Age, y[§]									
20–29	2088	11	0.46 (0.14–1.49)	146	0.46 (0.33–0.66)[‡]	70	0.41 (0.24–0.69)[‡]	120	0.55 (0.37–0.82)[‡]
30–39	3772	18	0.73 (0.23–2.39)	318	0.54 (0.42–0.69)[‡]	141	0.49 (0.33–0.72)[‡]	288	0.63 (0.48–0.83)[‡]
40–49	3172	23	0.74 (0.31–1.78)	454	0.53 (0.42–0.67)[‡]	265	0.62 (0.46–0.83)[‡]	476	0.71 (0.57–0.89)[‡]
50–59	2598	14	0.51 (0.17–1.51)	607	0.60 (0.48–0.74)[‡]	377	0.82 (0.63–1.06)	667	0.73 (0.59–0.91)[†]
60–69	1545	7	0.74 (0.16–3.40)	493	0.79 (0.62–1.01)	297	0.82 (0.60–1.12)	513	0.83 (0.65–1.07)
≥70	2771	13	0.73 (0.23–2.32)	1145	0.99 (0.83–1.18)	704	0.90 (0.73–1.10)	1125	1.06 (0.88–1.26)
Medical conditions[‖]									
0	8955	37	0.55 (0.30–1.02)	1160	0.59 (0.52–0.68)[‡]	572	0.62 (0.52–0.75)[‡]	1109	0.73 (0.63–0.84)[‡]
1	4404	31	0.67 (0.27–1.66)	1051	0.72 (0.61–0.84)[‡]	674	0.85 (0.69–1.03)	1113	0.83 (0.70–0.98)[†]
≥2	2587	14	0.87 (0.31–2.42)	945	0.85 (0.70–1.03)	641	0.86 (0.68–1.07)	967	0.92 (0.76–1.12)
Preoperative hospitalization[¶]									
No	12,049	59	0.63 (0.37–1.09)	1770	0.63 (0.56–0.70)[‡]	1013	0.68 (0.58–0.79)[‡]	1837	0.77 (0.68–0.87)[‡]
Yes	3897	23	0.66 (0.29–1.52)	1386	0.82 (0.70–0.96)[†]	874	0.86 (0.72–1.04)	1352	0.89 (0.75–1.04)

CI = confidence interval, ICU = intensive care unit, ME = medical expenditure, OR = odds ratio.

[*] Adjusted for all covariates in Table 1 except sex.

[†] $P < 0.05$.

[‡] $P < 0.0001$.

[§] Adjusted for all covariates in Table 1 except age.

[‖] Adjusted for all covariates in Table 1 except coexisting medical conditions.

[¶] Adjusted for all covariates in Table 1.

Table 4

Adjusted ORs and 95% CIs of postoperative adverse events associated with working facility and physician types.

	n	Deep wound infection		Prolonged length of stay		ICU stay		Increased ME	
		Events	OR (95% CI)*	Events	OR (95% CI)*	Events	OR (95% CI)*	Events	OR (95% CI)*
Nonhealth workers	7973	50	1.00 (reference)	1748	1.00 (reference)	1034	1.00 (reference)	1692	1.00 (reference)
Physician characteristics									
Type of practice									
TCM	624	0	–	128	0.92 (0.73–1.16)	66	0.83 (0.60–1.14)	119	0.84 (0.65–1.08)
Internal medicine	4952	18	0.57 (0.33–1.00)	893	0.68 (0.61–0.75)[†]	538	0.74 (0.65–0.85)[†]	935	0.80 (0.72–0.89)[†]
Surgery-related	1090	7	0.98 (0.44–2.19)	204	0.63 (0.53–0.76)[†]	138	0.74 (0.59–0.93)[‡]	242	0.81 (0.68–0.98)[‡]
Dentists	1307	7	0.81 (0.36–1.80)	183	0.64 (0.53–0.78)[†]	111	0.71 (0.55–0.90)[‡]	201	0.76 (0.63–0.92)[‡]
Working facility									
Work at clinic	5245	23	0.70 (0.41–1.19)	1085	0.74 (0.66–0.82)[†]	659	0.77 (0.67–0.88)[†]	1139	0.84 (0.76–0.94)[‡]
Work at hospital	2318	8	0.59 (0.30–1.17)	297	0.61 (0.53–0.71)[†]	181	0.71 (0.59–0.85)[†]	332	0.73 (0.63–0.84)[†]
Work at medical center	410	1	0.28 (0.04–2.10)	26	0.46 (0.33–0.66)[†]	13	0.56 (0.36–0.88)[†]	26	0.66 (0.47–0.93)[‡]
Medical conditions									
0	4474	15	0.55 (0.31–0.97)[‡]	499	0.64 (0.57–0.73)[†]	242	0.58 (0.50–0.69)[†]	519	0.74 (0.66–0.84)[†]
1	2197	9	0.60 (0.28–1.28)	470	0.68 (0.59–0.78)[†]	313	0.85 (0.72–1.00)	514	0.83 (0.73–0.95)[‡]
≥2	1302	8	1.09 (0.48–2.49)	439	0.78 (0.67–0.91)[‡]	298	0.94 (0.78–1.13)	464	0.88 (0.75–1.03)
Preoperative hospitalization									
No	6120	23	0.56 (0.34–0.92)[‡]	796	0.59 (0.53–0.65)[†]	457	0.63 (0.55–0.72)[†]	873	0.71 (0.64–0.79)[†]
Yes	1853	9	0.94 (0.45–1.97)	612	0.96 (0.83–1.10)	396	1.02 (0.87–1.21)	624	1.06 (0.92–1.22)

CI = confidence interval, ICU = intensive care unit, ME = medical expenditure, OR = odds ratio, TCM = traditional Chinese medicine.
* Adjusted for age, sex, teaching hospital, urbanization, coexisting diseases, Charlson Comorbidity Index, types of surgery, and types of anesthesia.
† $P < 0.0001$.
‡ $P < 0.05$.

expenditure. These differences were the most pronounced when comparing nonphysician controls with male, relatively young physicians, those with fewer coexisting medical conditions, or those without preoperative hospitalizations. In particular, dentists, physicians working at medical centers, and those without any coexisting medical conditions or record of preoperative hospitalization had the lowest risk of prolonged postoperative hospital stay, admission to ICU, or increased medical expenditure.

Patient's age and gender were also determinants of postoperative complications and mortality.[4,20,21] Hypertension, mental disorders, chronic obstructive pulmonary disease, diabetes, ischemic heart disease, hyperlipidemia, stroke, liver cirrhosis, and renal dialysis were considered as common coexisting medical conditions for surgical patients that may contribute to adverse events after surgeries.[4,20,21] In addition, types of surgery and anesthesia also determined the perioperative complications and mortality.[4,20,21] In this study, these sociodemographics, coexisting medical conditions, and characteristics of surgeries were comprehensively matched by propensity score (this method could remove 98% of the bias from measured covariates)[22] and adjusted in the multivariate logistic regressions when investigating postoperative adverse events between physicians and nonphysician surgical patients.

A first possible explanation is that physicians as surgical patients have better medical knowledge and health behaviors than the general population. Physicians' medical knowledge, health behaviors and insight into disease may help them recognize symptoms earlier and avoid delayed diagnosis or treatment, which definitely is a crucial determinant of clinical outcome.[23–26] Second, better communication among healthcare teams with physicians as patients may influence patients' medical outcomes.[27] Third, physicians' insider information may help them to select surgeons with greater skill, which is another important determinant for perioperative outcomes.[8,10] Fourth, physicians as surgical patients may have better medical support than general populations from their classmates, colleagues,

friends, or relatives who potentially also are healthcare workers and could provide more medical information, social or medical assistance and support perioperatively.[28] These types of support may be also helpful in reducing adverse events after surgery in patients who are physicians. However, further validation is needed in future prospective studies. However, the above possible explanations were assumptions or conjectures that were not supported by any of the data analyzed.

This study indicated that female physicians as surgical patients did not have advantages regarding reduced postoperative risk of deep wound infection, prolonged hospital stays, ICU admission, or elevated medical expenditure when compared to nonphysician controls. A cross-sectional self-reported survey indicated that the female physicians had a higher risk of impaired health status than male colleagues;[29] another large-scale health survey showed women's morbidity and use of medical resources was higher than men's.[30] Thus, differences in underlying health status between female and male physicians may partially account for this finding.

Unlike younger physician patients, those aged over 60 years did not show any advantages in terms of reduced postoperative hospital stay, risk of ICU admission, or medical expenditure when compared to the nonphysician controls. The elderly have more limited physiological reserves as well as more coexisting medical conditions associated with higher postoperative mortality, complications, prolonged length of hospital stay, and increased medical costs.[21,31] In addition, nontypical symptoms in elders often lead to delaying diagnosis and treatment that might worsen clinical outcomes.[32,33] Therefore, this study indicated that the advantages physicians have as surgical patients might gradually diminish as they grow older. This finding may also imply that postoperative advantages in terms of patient safety or medical expenditure may be limited in older physicians who are surgical patients.

The advantages of physicians as surgical patients compared with nonphysician controls were found among various subpopulations categorized by different numbers of coexisting

medical conditions and by records of preoperative hospitalization. However, these differences diminished with increasing coexisting medical conditions and preoperative hospitalization. These findings support our hypothesis that the physician–patient role is an independent determinant protecting these surgical patients from postoperative adverse effects. However, this protective effect could be reduced by progressively poorer health.

Except for traditional Chinese medicine physicians, this study indicated that dentists and physicians of Western medicine were at significantly lower risk for prolonged hospital stays, ICU admission, and elevated medical expenditure compared to nonphysician controls. We believed that all well trained physicians in any working environment should be familiar with the fact that more nosocomial infections follow more exposure.[34] Interestingly, physician surgical patients working in medical centers showed fewer adverse surgical outcomes than those working in nonhospital clinics or hospitals. This finding may imply that those more familiar with postoperative care had less risk of poor surgical outcomes.

This study has some limitations. First, we used retrospective medical claims data from Taiwan's National Health Insurance. This information lacks details on patients' socioeconomic status, lifestyles, and laboratory examinations. Several studies have analyzed socioeconomic status (including education, income, and levels of occupation) relative to postoperative outcomes, including colorectal cancer surgery, joint replacement surgery, and cardiovascular surgery.[5,35–38] Lower socioeconomic status increased postoperative complications, medical expenditure, length of stay, and mortality.[5,35–38] Although low-income patients were excluded from this study, we believe physicians have better socioeconomic status than control, and this may contribute to better postoperative outcomes.

Another limitation is the retrospective study design using only reimbursement data. Medical records from reimbursement claims for coexisting medical conditions and postoperative complications might under-report because people with these illnesses may not visit medical care services. However, these data should be distributed equally between both groups without causing bias in the results. We excluded other clinical care workers to strictly identify the control group. In addition, although we controlled for several confounders, residual confounding bias is possible due to perioperative factors not considered here, such as surgeon characteristics, level of hospital, and other coexisting medical conditions.

5. Conclusion

This study showed that physicians as surgical patients had fewer postoperative adverse events compared with nonphysician controls, particularly young male physicians and dentists. This implies that medical knowledge may play an important role in surgical outcomes. Therefore, resources and preoperative education should be reconsidered to enhance nonexperts' medical knowledge to reduce postoperative adverse outcomes.

Acknowledgments

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