Supplementary table 1. Descriptive characteristics of the included studies

Study	Physician and patient characteristics				Setting		Interventions or	Outcomes
Country	Type	n=	Sex (% male)	Age	Location	Urban or rural	exposures	
Observational (exposure) studies (n=45)								
Cohort design								
Chu, 2011 [32] Canada	Surgeons	6	NR	Range: 32-55y	Tertiary care academic hospital	Urban	Insufficient sleep due to work on the night preceding surgery	Length of surgery; patient postoperative mortality, complications, length of stay
	Patients: cardiac surgery cases	4,047	NR	NR				
Ellman, 2004 [41] US	Surgeons	NR	NR	NR	University hospitals	Urban	Insufficient sleep due to work on the night preceding surgery	Length of surgery; patient complications, in-hospital mortality, length of stay, need for blood products
	Patients: adult cardiac surgery cases	6,751	70%	S: 63.4±0.7y C: 63.5±0.1y				
Govindarajan, 2015 [31] Canada	Surgeons	1,448	NR	46.3±8.7	Academic and non-academic hospitals	Mixed	Sleep deprivation due to work on the night preceding a daytime surgery	Length of surgery; Patient complications, mortality, readmissions, length of stay
	Patients: surgical cases	38,978	NR	56.4±16.6y				
Rothschild, 2009 [58] US	Surgeons Obstetrician/gynecologists	220	Surgeons: 84% OB/GYNs: 28%	Surgeons: 42.0±7.6y OB/GYNs: 42.0±9.0y	Tertiary care academic trauma centre/referral centre for high-risk obstetrics	Urban	Sleep deprivation due to work on the night preceding a daytime procedure	Patient complications, preventable complications
	Patients: surgical and obstetrics cases	Surg.: 4,471 Obst.: 4,902	Surg: S: 25% C: 28% Obst.: S: 0% C: 0%	Surg: S: 49.1±16.3y C: 50.0±16.3y Obst.: S: 32.9±5.2y C: 33.5±5.0y				
Schieman, 2007 [63] Canada	Colorectal surgeons	NR	NR	NR	University teaching hospitals	NR	Fatigue due to work on the night preceding surgery	Length of surgery; patient operative complications, length of stay, mortality, cancer recurrence
	Patients: undergoing anterior resection for rectal cancer	270	NR	S: 64.5y C: 64.4y				

Study Country	Physician and patient characteristics Type	n=	Sex (% male)	Age	Setting Location	Urban or rural	Interventions or exposures	Outcomes
Vinden, 2014 [77] Canada	General surgeons	331	83%	48±10y	Community hospitals	Mixed	Sleep deprivation due to overnight work preceding daytime surgery	Patient mortality, operative complications
	Patients: Elective cholecystectomies	10,390	S: 27% C: 26%	S: 49±16y C: 49±16y				
Before-after design								
Amirian, 2014 [34] Denmark	Surgeons	29	55%	Median: 35y Range: 27-49y	Academic hospital	Urban	17-h night shift with sleep deprivation	Cognitive and psychomotor abilities on a laparoscopic simulation
Gerdes, 2008 [45] US	Surgeons	9	NR	NR	University Hospital	Urban	Fatigue; sleep deprivation from overnight call shift	Cognitive and psychomotor abilities
Lederer, 2006 [50] Austria	Senior anesthetists	11	82%	49.0±2.0y	Hospital	Urban	Sleep deprivation from 24-h call shift	Concentration ability; reaction time; performance on psychometric tasks
Time series design								
Leichtfried, 2011 [51] Austria	Anesthetists	10	100%	Mean: 32y Range: 29-35y	University Hospital	Urban	Sleep deprivation from 24-h shift; sleepiness, sleep hours	Melatonin metabolite profile
Cross-sectional design								
Aziz, 2004 [35] US	Family medicine physicians Various specialties	153	NR	NR	Hospitals	NR	Fatigue	Stress
Beaujouan, 2005 [36] France	Anesthesiologists	3,476	64%	≤35y: 9% 36-45y: 28% 46-55y: 49% 56-65y: 13%	Public sector General hospitals University hospitals Private hospitals	NR	Sleep deprivation	Substance abuse
Chang, 2013 [37] US	Anesthesiologists	11	64%	Mean: 38y IQR: 34-48y	Level 1 trauma centre	NR	Sleep deprivation due to 15-h overnight call shift; sleepiness	Cognitive performance; reaction time

Study Country	Physician and patient characteristics Type	n=	Sex (% male)	Age	Setting Location	Urban or rural	Interventions or exposures	Outcomes
Chen, 2008 [38] US	Psychiatrists Internists General practitioners Surgeons Obstetrician-gynecologists Radiologists Pediatricians Other	180	77%	Academic: 79% 36-55y Private practice: 73% 36-65y	Medical school Private practices	Urban	Sleep deprivation; sleepiness	Impact on personal and professional life; perceived risk of errors
Doppia, 2011 [39] France	Anesthesiologists	565	64%	<35y: 11% 35-54y: 63% >55y: 25%	Public hospitals Private hospitals Work-health environments Public health units	NR	Sleep deprivation	Burnout
Elovaino, 2015 [42] Finland	Physicians in various specialties	1,524	40%	Median: 49.7y Range: 24-69y	Hospitals Primary care Private practice Other unspecified	NR	Sleep difficulties	Job demands and control
Gander, 2000 [43] New Zealand	Anesthetists	183	NR	Mean: 46y	Combined public/private practice Other unspecified	NR	Work-related sleep disturbance	Risk of fatigue-related errors
Harbeck, 2015 [46] Germany	Internists	20	45%	Median: 32y Range: 26-42y	Hospital	NR	Sleep disturbance due to a 24-call shift	Biochemical and physiological parameters; neurocognitive function
Heponiemi, 2014 [47] Finland	Physicians in various specialties Non-specialized physicians	1,541	40%	49.80±9.49y, Range: 24-67y	Hospitals Primary care clinic Private practice Other unspecified	NR	Sleep difficulties	Job satisfaction; work ability; psychological distress

Study Country	Physician and patient characteristics Type	n=	Sex (% male)	Age	Setting Location	Urban or rural	Interventions or exposures	Outcomes
Jackson, 2017 [48] US	Surgeons in various subspecialties	993	61%	More; less satisfied: 30-39y: 23%;24% 40-49y: 32%;36% 50-59y: 23%;27% ≥60y: 23%;14%	Academic practice Non-academic practice	NR	Not feeling well rested	Job satisfaction
Kanieta, 2011 [49] Japan	Internists Surgeons Orthopedics Pediatricians Obstetrician-gynecologists Psychiatrists Dermatologists Urologists Opthalmologists Otorhinolaryngologists Other	3,486	66%	20-39y: 11% 40-49y: 25% 50-59y: 28% 60-69y: 16% ≥70y: 21%	Hospitals Clinics Other unspecified	NR	Sleep deprivation and difficulties; insomnia	Medical incidents
Lindfors, 2006 [52] Finland	Anesthetists	328	53%	47±7.8y Range: 32-69y	University hospitals Central and district hospitals Private sector	NR	Sleep disturbances; sleepiness	Stress; suicidal tendencies
Mahmood, 2016 [53] Norway	Generalists Internists Pediatricians Surgical specialties Anesthesiologists	450 (all time points)	41%	43y±2.8y	Public health system Private practice	NR	Sleep deprivation due to on-call shifts	Alcohol misuse

Study Country	Physician and patient characteristics Type	n=	Sex (% male)	Age	Setting Location	Urban or rural	Interventions or exposures	Outcomes
Nishimura, 2014 [54] Japan	Neurosurgeons and neurologists	2,564	NR	NR	Stroke care centres Teaching hospitals	NR	Sleep deprivation	Burnout
Pit, 2014 [55] Australia	General practitioners	92	60%	50±10.7y	NR	Rural	Work-related sleep disturbance	Early retirement intentions
Pit, 2016 [56] Australia	General practitioners	92	60%	50±10.7y	Private (solo) practice Group practice	Rural	Work-related sleep disturbance	Sickness presenteeism
Roberts, 2014 [57] US	General internists Internal medicine hospitalists	578	58%	Hospitalists: 46.9±12.4y Generalists: 53.6±10.2y	Private practice Academic medical centre Veterans hospital Military practice Other	NR	Fatigue	Falling asleep while driving
Saadat, 2016 [60] US	Anesthesiologists	21	71%	30-40y: 57% 41-50y: 19% 51-55y: 24% Range: 32-56y	Tertiary care academic children's hospital	NR	Sleep deprivation due to 17-h night call shift	Mood disturbances
Saadat, 2017 [59] US	Anesthesiologists	21	65%	Range: 32-56 years	Tertiary care academic children's hospital	NR	Sleep deprivation due to 17-h night call shift	Reaction time
Sanches, 2015 [61] Spain	Emergency medicine physicians	18	28%	29.2±2.6y	Central hospital	NR	Sleep deprivation	Cognitive and psychomotor abilities
Sargent, 2009 [62] US	Orthopedic surgeons	264	92%	NR	Orthopedic surgery training programs	NR	Sleep deprivation	Burnout; psychological distress; marital satisfaction
Sende, 2012 [64] France	Emergency physicians	318	62%	39±8y	Hospitals Mobile emergency services Other unspecified	NR	Fatigue; sleep deprivation	Stress

Study Country	Physician and patient characteristics Type	n=	Sex (% male)	Age	Setting Location	Urban or rural	Interventions or exposures	Outcomes
Sexton, 2001 [65] US	Consulting physicians: Surgeons Anesthesiologists Pulmonary physicians Cardiologists Pediatricians	271	NR	NR	Teaching and non-teaching hospitals	Urban	Fatigue	Perceived performance effectiveness
Shanafelt, 2005 [67] US, Canada, Mexico	Oncologists	241	85%	>50y: 51%	Community clinics Hospitals Private practice Academic medical centres	NR	Fatigue; sleep deprivation	Quality of life/well-being
Shanafelt, 2010 [66] US	Surgeons	7,905	87%	Median: 51y Q1: 43y Q2: 59y	Private practice Academic medical centres Veterans hospital Active military practice Retired or not in practice Other	NR	Fatigue	Perceived major medical errors
Shanafelt, 2014 [68] US	Oncologists	1,117	52%	Median: 52y	Private practice Academic practice Veteran's hospital Industry, other	NR	Fatigue	Satisfaction with work-life balance
Shirom, 2006 [69] Israel	Opthalmologists Dermatologists Otolaryngologists Gynecologists General surgeons Cardiologists	890	80%	Median: 52y SD: 7.2y	Community clinics Acute care hospital outpatient clinics	NR	Physical fatigue	Perception of quality of patient care

Study Country	Physician and patient characteristics Type	n=	Sex (% male)	Age	Setting Location	Urban or rural	Interventions or exposures	Outcomes
Shirom, 2010 [70] Israel	Opthalmologists Dermatologists Otolaryngologists Gynecologists General surgeons Cardiologists	890	80%	Median: 52y SD: 7.2y	Community clinics Acute care hospital outpatient clinics	NR	Physical fatigue	Burnout
Smith, 2017 [71] UK	General practitioners Surgeons Other unspecified specialties	3,550	63%	NR	NR (varied)	NR	Perceived fatigue, sleep deprivation	Physical and mental health; competence
Starmer, 2016 [72] US	General pediatricians Pediatric surgeons Pediatric hospitalists Pediatric specialists (unspecified)	840	40%	NR	NR (some in private practice)	NR	Sleep deprivation	Burnout; balanced personal and professional commitments; life and career satisfaction
Tanti, 2017 [73] Malta	Physicians (unspecified)	204	62%	Median: 41y	Hospitals Community Office-based	NR	Fatigue	Prescribing errors
Tokuda, 2009 [74] Japan	Hospital physicians: Generalists Other unspecified specialties	236	75%	40.9±7.8y Range: 26-76y	Hospitals with ≥20 inpatient beds	NR	Sleep deprivation	Burnout; job satisfaction
Vela-Bueno, 2008 [76] Spain	Primary care physicians	113	27%	41.4±8.0y	Primary care centres	Urban	Sleep problems, insomnia	Burnout
Wada, 2010 [78] Japan	Physicians (unspecified)	3,862	78%	M: 75% 30-59y F: 85% 30-59y	Hospitals	NR	Sleep deprivation	Depressive symptoms

Study Country	Physician and patient characteristics Type	n=	Sex (% male)	Age	Setting Location	Urban or rural	Interventions or exposures	Outcomes
Non-comparative design								
Gander, 2008 [43] New Zealand	Anesthetists	20	85%	Median: 44y	Hospitals	Urban	Sleep disturbance from consecutive working days or on-call work	Psychomotor performance
Intervention studies (n=2)								
Randomized controlled trials								
Dutheil, 2013 [40] France	Emergency physicians	17	35%	39.1y±6.9y	University hospital	Urban	Fatigue related to 14-h and 24-h shifts; sleep deprivation; low sleep quality;	Perceived stress; urine interleukine-8
Uchal, 2005 [75] Norway	Surgeons Gynecologists Orthopedic surgeons Urologists Vascular surgeons	64	67%	Median: Post-call: 33.0y Post-work: 38.0y	Government hospitals	NR	Sleep deprivation due to 24-h call shift	Product quality, procedure effectiveness of a surgical simulation

C: control group; F: female; h: hour(s); IQR: interquartile range; M: male; NR: not reported; S: study group; SD: standard deviation; Surg: surgical; Obst: obstetric; Q: quartile; UK: United Kingdom; US: United States of America; y: year(s)