



Suicide mortality among physicians, dentists, veterinarians, and pharmacists as well as other high-skilled occupations in Austria from 1986 through 2020

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ABSTRACT

Some evidence puts health professionals at increased risk of suicide, especially females, whereas other research suggests a lower risk in high-skilled occupations. This study investigated the suicide risk of four health professions (physicians, dentists, veterinarians, pharmacists) and three other high-skilled occupations (notaries, lawyers, tax advisors/public accountants) in Austria compared to the general population, and analyzed suicide methods across occupations. Data was collected from professional associations and Austrian cause-of-death statistics to determine suicide cases. Gender-specific standardized mortality ratios (SMRs), crude and age-adjusted suicide rates and frequencies for suicide methods were calculated for each profession (maximum time span 1986–2020). Among males, only veterinarians had a significantly elevated suicide risk compared to the general population. Physicians and tax advisors/public accountants had a significantly lower suicide risk. Among females, the veterinarians, physicians, and pharmacists had a significantly elevated suicide risk; for dentists, it was also elevated, though non-significantly. Age-adjusted suicide rates showed a smaller gap between men and women in all professions compared to the general population. Poisoning was the predominant suicide method among health professions, except dentists. These findings are consistent with some of the prior literature and call for specific suicide prevention efforts in health professions, focusing on women.

1. Introduction

A number of occupations have been linked to an increased suicide risk, with several health professions among them (Roberts et al., 2013; Windsor-Shellard and Gunnell, 2019). Physicians especially have been the subject of many studies on suicide prevalence. A meta-analysis found an increased standardized mortality ratio (SMR) for suicide, 2.3 times higher for female physicians and 1.4 times higher for male physicians compared to the general population (Schernhammer and Colditz, 2004). Elevated mortality from suicide in physicians forms a contrast to their general life expectancy, which has been shown to be higher than in other occupational groups (Frank et al., 2000). However, results about suicide risk are not consistent across studies, which rely on different data

sources and outcome measures. For example, proportionate mortality ratios (PMRs) are often used in studies of suicide prevalence and are known to inflate risk in populations with lower all-cause mortality (Roberts et al., 2013). SMRs and standardized rate ratios are more suitable for comparison, but the more recent research paints a varied picture even when excluding PMRs: some studies showed increased suicide rates for both male and female physicians (Aasland et al., 2011; Hawton et al., 2011; Torre et al., 2005), others only found elevated suicide rates for women (Irigoyen-Otiñano et al., 2022; Milner et al., 2016; Petersen and Burnett, 2008), and a few showed no increased risk for either gender (Davis et al., 2021; Yaghmour et al., 2017; Shang et al., 2011; Skegg et al., 2010). The evidence regarding suicide rates of dentists is similarly mixed. Most of the available studies focused on male

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dentists, and many showed increased suicide rates (Hostettler and Minder, 2002; Shimpo et al., 1998; Simpson et al., 1983; Rose and Rosow, 1973; Hill and Harvey, 1972) whereas others did not (Skegg et al., 2010; Petersen and Burnett, 2008). Of those studies that included both male and female dentists, some found elevated suicide rates for both genders (Hawton et al., 2011; Stefansson and Wicks, 1991; Bamayr and Feuerlein, 1986) and some just for males but not for females (Hem et al., 2005; Arnetz et al., 1987). The evidence for increased suicide rates among veterinarians is more consistent, with several studies showing an elevated risk for men and women (Witte et al., 2019; Milner et al., 2015; Platt et al., 2010) and fewer studies showing no increase (Hawton et al., 2011; Skegg et al., 2010). Pharmacists are another health profession that has been linked to higher suicide rates, although they are included in fewer studies. One study found increased suicide rates for pharmacists as a professional group at several time points between 2004 and 2014 (Lee et al., 2022), one study (Hawton et al., 2011) reported higher rates for male and female pharmacists, and another one (Skegg et al., 2010) only for female pharmacists.

The potentially higher suicide risk in health professions is also of special interest considering that several studies indicate that high-skilled professionals as a broad occupational category have lower suicide rates (Windsor-Shellard and Gunnell, 2019; Mustard et al., 2010). High-skilled occupations typically include managerial and professional positions requiring certain educational attainments and/or training to develop competence at specific high-level skills, as defined for example by the International Standard Classification of Occupations (International Labour Office, 2022). A meta-analysis showed a gradient relationship between skill level and suicide, with the highest risk elevation in the lowest skill-level group (Milner et al., 2013). This study also revealed a gender difference (though not significant) in the highest skill-level group (which would include the above mentioned health professions), with lower suicide risk among men and higher suicide risk among women compared to the working-age population. Higher skill-level generally tends to result in better income, and higher socio-economic status has been associated with lower suicide risk (Rehkopf and Buka, 2006); when suicide rates are adjusted for income, the differences between various occupational groups are diminished (Agerbo et al., 2007). Higher educational attainment has also been associated with lower suicide risk (Lorant et al., 2005), although there is evidence that this lower risk only applies to men (Øien-Ødegaard et al., 2021). One notable aspect where health professions differ from others is access to means of suicide that are more likely to result in death, which is also a known risk factor for suicide (Milner et al., 2017). Medical knowledge combined with access to highly effective substances can lead to more suicide deaths by health professionals, and there is substantial evidence that poisoning as a suicide method is much more commonly used among health occupations (Davis et al., 2021; Kölves and De Leo, 2013; Stalones et al., 2013).

This study aims to a) compare suicide risk among several health professions (physicians, dentists, veterinarians, pharmacists) and other high-skilled professions (notaries, lawyers, tax advisors/public accountants) to the general population in Austria by calculating SMRs for the maximum time period in which data was available and suicide rates for a common time span across groups, and to b) assess the most commonly used suicide methods within these occupational groups compared to the general population. We hypothesize that health professionals have an increased suicide risk compared to the general population (with a higher elevation of risk among females), whereas all other high-skilled professionals have a lower suicide risk compared to the general population. This study is the first to examine suicide risk for occupational groups in Austria, including not only health professions but other high-skilled occupations in a joint analysis.

2. Methods

2.1. Study population

The study population included professionals from occupational groups with established professional chambers in Austria. Membership in the respective chambers is mandatory, and there are nine in total: the Austrian Medical Chamber, Dental Chamber (established in 2006, before that dentists were part of the Medical Chamber), Chamber of Veterinary Surgeons, Chamber of Pharmacists, Chamber of Tax Advisors and Public Accountants, Chamber of Architects and Engineer Consultants, Chamber of Patent Attorneys, Chamber of Civil-Law Notaries and the Austrian Bar. One of these professional groups (patent attorneys) was not included in this study due to the size of their membership (about 80 members in 2021), which was deemed too small for the analysis of a rare event such as suicide. All others were eligible to participate.

2.2. Data collection

The remaining eight chambers were contacted and invited to contribute to this study by providing lists of their deceased members from 1970 onwards (or for whatever available time period). The Chamber of Architects and Engineer Consultants declined this invitation, and the Austrian Bar delegated this decision to the regional Bars in the Austrian federate states, of which five participated (Burgenland, Lower Austria, Upper Austria, Vienna, Vorarlberg) and four opted out (Carinthia, Salzburg, Styria, Tyrol). All others agreed to participate, and some had the data prepared by specific economic institutions responsible for detailed membership information, payments, pensions etc. (general salary fund of Austrian pharmacists, pension insurance institute of the Austrian civil-law notaries, pension fund for Austrian lawyers). Additionally, all participating institutions were asked to provide information on yearly membership numbers and age distribution among their members (stratified by gender) for the respective time periods. For the lawyers, no gender-stratified age distribution was available on the level of individual federate states, so the gender proportions and age distribution of Austrian lawyers were applied to the membership numbers of participating federate states as an approximation. For the dentists, no gender-stratified age distribution was available after 2006, so the gender-stratified age distribution of physicians was applied to the membership numbers provided by the Dental Chamber (after a comparison of the gender- and age-distribution between physicians and dentists for the time period before 2006 revealed only small differences). All data on notaries also include candidate notaries due to organizational reasons.

The provided information on deceased members (or, in case of physicians and dentists, those whose membership was terminated for whatever reason) was used for data collation with the Austrian cause-of-death statistics, from which cause and date of death was obtained. This process of data collation can be used for all deaths after 1970, but the actual observation period for all included professions started later (e.g. due to the availability of data about deceased members or information on age distribution). The cause-of-death statistics is provided by Statistics Austria (the federal statistical office) and is based on medically documented information on death certificates, generally considered one of the most reliable sources of health data in Austria (Statistics Austria, 2022). Causes of death are categorized according to the International Classification of Diseases (ICD) used at the time, with the following codes indicating suicide: E950-E959 (ICD-9, used in Austria from 1986–2001) and X60-X84, Y87.0 (ICD-10, used from 2002 onwards). The codes from both ICD editions refer to the same broad categories, hence suicide as a cause of death and the overarching categories of suicide methods are comparable across ICD-9 and ICD-10. Since there was no evidence indicating a higher proportion of deaths with undetermined intent among the occupational groups, cases with the codes E980-E989 (ICD-9) and Y10-Y34, Y87.2 (ICD-10) were not included in

the analysis of suicides. There were some members in each professional group whose cause of death could not be determined; since not all of the professional associations submitted lists of deceased persons only, the extent of missing causes of death could only be established for some groups (veterinarians, pharmacists, notaries, tax advisors/public accountants, lawyers) and ranged between 5.4 and 10.6% of cases (see Table 1). In order to compare the professional groups with the general population, data on suicides within the Austrian general population was also obtained from the cause-of-death statistics; population size and age distribution were acquired from yearly data provided by Statistics Austria. This research was approved by the Ethics Committee of the Medical University of Vienna.

2.3. Statistical analysis

In order to compare the suicide mortality of these professional groups with the Austrian general population, SMRs with 95% confidence intervals (based on Mid-P exact test, a commonly used method for low numbers of observed deaths (Soe and Sullivan, 2006)) were calculated (overall and stratified by gender). The maximum observation periods were not the same for all groups: for physicians, dentists, and veterinarians the maximum observation period was 1986–2020 (35 years), for pharmacists and notaries 1991–2020 (30 years), for tax advisors/public accountants 1994–2020 (27 years), and for lawyers 1998–2020 (23 years). Age was indirectly standardized using the Austrian general population as a reference group for the respective time periods, based on 10-year age categories. The lower limit of the age range varied between professional groups and was typically not specified in the membership statistics, but can be assumed to be between 21 and 25 years depending on the educational requirements of the profession. The upper limit of the age range was 65 years for pharmacists and 64 years for all other professions, which corresponds roughly with the typical Austrian retirement age of 65 years.

To facilitate comparison between genders, directly age-standardized suicide rates per 100,000 population were calculated for each professional group (stratified by gender) by using the 2013 European Standard Population. Relative frequencies were used to compare the distribution of the most commonly used suicide methods of the Austrian general population (between 1998 and 2020) across these occupational groups. Data analyses were performed with the Statistical Product and Service Solutions (SPSS) Statistics 27.0 software.

Table 1
Characteristics of deceased Austrian professionals for the maximum time periods of data availability.

	Physicians	Dentists	Veterinarians	Pharmacists	Notaries	Tax advisors/ public accountants	Lawyers
Maximum time period	1986–2020	1986–2020	1986–2020	1991–2020	1991–2020	1994–2020	1998–2020
Person-years, men	639 087	76 533	41 400	31 304	20 782	96 330	65 403
Person-years, women	448 319	50 627	34 695	110 169	4 284	61 545	14 251
Nr of deaths	N/A	N/A	199	231	51	168	119
Nr of deaths, unknown cause (%)	N/A	N/A	21 (10.6)	23 (10.0)	5 (9.8)	9 (5.4)	8 (6.7)
Nr of deaths, known cause	1701	224	178	208	46	159	111
Men (%)	1230 (72.3)	170 (75.9)	145 (81.5)	84 (40.4)	45 (97.8)	119 (74.8)	107 (96.4)
Women (%)	471 (27.7)	54 (24.1)	33 (18.5)	124 (59.6)	1 (2.2)	40 (25.2)	4 (3.6)
Mean age at death							
Men (SD)	53.5 (8.8)	55.6 (8.1)	53.9 (9.1)	55.7 (8.4)	56.4 (7.9)	53.6 (8.3)	54.8 (8.3)
Women (SD)	50.2 (9.9)	54.4 (7.1)	48.3 (9.6)	54.0 (9.8)	N/A	49.8 (8.1)	56.8 (4.8)
Nr of suicides	212	24	36	26	5	19	12
Men (%)	147 (69.3)	16 (66.7)	27 (75)	10 (38.5)	5 (100)	15 (78.9)	12 (100)
Women (%)	65 (30.7)	8 (33.3)	9 (25)	16 (61.5)	0 (0)	4 (21.1)	0 (0)
Mean age at suicide							
Men (SD)	47.8 (9.9)	48.1 (8.7)	47.8 (8.8)	51.1 (8.2)	55.0 (7.3)	48.5 (10.5)	47.3 (9.7)
Women (SD)	42.6 (10.1)	52.6 (8.2)	42.1 (10.1)	48.4 (11.3)	N/A	48.8 (2.5)	N/A

3. Results

3.1. Description of participants

The cause of death was identified for a total number of 2,627 deceased persons across all occupations for the maximum time period of data availability (the same information for the common time span of 1998–2020 can be found in the supplement, Table A). Physicians constituted the biggest group with 1,701 deaths, notaries the smallest with 46 (details in Table 1). The mean age at death for male professionals was between 53.5 and 55.7 years. In all but one occupation (lawyers) the male mean age at death was higher than the female mean age. Men formed the majority of deaths in all occupations except pharmacists (59.6% women), most likely due to male overrepresentation in these professions. Notaries and lawyers displayed the most drastic gender imbalance with only 2.2% and 3.6% of deceased women respectively. Of the total number of 334 suicides, the physicians again constituted the biggest group with 212, the notaries the smallest with 5. The mean age at death from suicide ranged from 47.3 to 55.0 years for men and 42.1 to 52.6 for women, which was lower than the mean age at death from all causes. The majority of suicides were committed by men in all professions except pharmacists (61.5% women). In all four health professions (physicians, dentists, veterinarians, pharmacists) the percentage of women who died from suicide was higher than the proportion of female members in these respective occupations. There were no suicides among female lawyers or notaries, likely due to the small fraction of deceased women.

3.2. SMRs for suicide

Table 2a lists the SMRs for the maximum time period of each occupational group. Among male professionals, veterinarians were the only ones with significantly elevated suicide risk, which was more than twice as high compared to the male general population (SMR 2.12, 95%CI 1.42–3.04). All SMRs for other male professionals were close to or lower than 1, with significant SMRs of 0.74 (95%CI 0.63–0.87) for physicians and 0.55 (95%CI 0.32–0.89) for tax advisors/public accountants. The results were different for female professionals: SMRs were above 1 for all four health professions, indicating that female veterinarians were almost three times as likely to die from suicide compared to women of the general population (SMR 2.96, 95%CI 1.44–5.43). The SMRs for female physicians and pharmacists were also significantly higher at 1.58 (95%

Table 2a

SMR for suicide by occupational group and gender, for the maximum time period available.

	Time period	Men			Women			Overall (gender-adjusted)		
		Suicides	SMR	95%CI ^a	Suicides	SMR	95%CI ^a	Suicides	SMR	95%CI ^a
Physicians	1986–2020	147	0.74*	0.63–0.87	65	1.58*	1.23–2.01	212	0.89	0.78–1.02
Dentists	1986–2020	16	0.68	0.40–1.07	8	1.74	0.81–3.30	24	0.85	0.56–1.24
Veterinarians	1986–2020	27	2.12*	1.42–3.04	9	2.96*	1.44–5.43	36	2.28*	1.62–3.12
Pharmacists	1991–2020	10	1.09	0.56–1.95	16	1.73*	1.02–2.74	26	1.41	0.94–2.04
Notaries	1991–2020	5	0.84	0.31–1.86	0	N/A		5	0.80	0.29–1.77
Tax advisors/public accountants	1994–2020	15	0.55*	0.32–0.89	4	0.81	0.26–1.95	19	0.59*	0.37–0.90
Lawyers	1998–2020	12	0.70	0.38–1.18	0	N/A		12	0.65	0.35–1.11

^a 95%CI was calculated based on the Mid-P exact test.

* Statistically significant.

CI 1.23–2.01) and 1.73 (95%CI 1.02–2.74) respectively, and while the SMR for female dentists was not statistically significant, it was also elevated at 1.74 (95%CI 0.81–3.30). No SMRs were calculated for female notaries and lawyers since there were no suicides in those groups, so the only other available profession for comparison were female tax advisors/public accountants with an SMR of 0.81 (95%CI 0.26–1.95). When looking at the overall, gender-adjusted SMRs for each professional group, the increased risk for females in male-dominated health professions still resulted in SMRs lower than 1, with the exception of veterinarians where both genders had elevated rates. In a female-dominated profession like pharmacists, the SMR was higher than 1, but not statistically significant.

Because available time periods differed between occupational groups, SMRs were also calculated for a common time span across all groups (1998–2020, see supplement Table B). There were no striking differences in SMRs regarding male professionals and only one notable variation in the SMRs of female professionals in case of pharmacists, which was much lower at 1.17 (95%CI 0.54–2.22) compared with 1.73 (95%CI 1.02–2.74) for the time period of 1986–2020. The suicide numbers in most occupational groups were too small for more detailed analyses, but an additional analysis of changes in SMRs over time was possible for male and female physicians (Table 2b). When comparing the last three decades (1991–2000, 2001–2010, 2011–2020), the SMRs of female physicians steadily decrease from 2.77 (95%CI 1.84–4.04) to 1.44 (95%CI 0.88–2.24). The opposite trend can be seen among male physicians, where the SMRs increased from 0.72 (95%CI 0.53–0.96) to 0.86 (95%CI 0.63–1.15).

3.3. Suicide rates

Crude as well as age-adjusted suicide rates based on the European Standard Population 2013 (Eurostat, 2013) were calculated for all professional groups and the Austrian general population within the same age range during the common time span (1998–2020). As shown in Table 3, the suicide rates of males in the general population were more than three times as high as those of females, whereas this gap was not as large for the analyzed high-skilled occupational groups. When comparing age-adjusted rates, female dentists had a similarly high rate as males, and the rate of male physicians was roughly 1.5 times as high as among females. Male pharmacists had double the suicide rate of

Table 2b

SMR for suicide among physicians by gender over time, for three consecutive 10-year intervals.

Time period	Men			Women			Overall (gender-adjusted)		
	Suicides	SMR	95%CI ^a	Suicides	SMR	95%CI ^a	Suicides	SMR	95%CI ^a
1991–2000	43	0.72*	0.53–0.96	25	2.77*	1.84–4.04	68	0.99	0.78–1.25
2001–2010	45	0.80	0.59–1.06	17	1.55	0.93–2.43	62	0.92	0.71–1.17
2011–2020	42	0.86	0.63–1.15	18	1.44	0.88–2.24	60	0.98	0.75–1.25

^a 95%CI was calculated based on the Mid-P exact test.

* Statistically significant.

females, and for veterinarians and tax advisors/public accountants the male rates were about 2.3 times as high. However, due to the small number of suicides in the analysis (especially among female professionals), there was a high level of uncertainty regarding the age-adjusted suicide rates, which manifests in rather large confidence intervals.

3.4. Suicide methods

The five most commonly used suicide methods in the Austrian general population between 1986–2020 account for 91% of all suicides and were compared across occupational groups (maximum time period), with some notable differences (see Fig. 1, supplement Table C). In the general population of the same age range, hanging/strangulation/suffocation was the dominant method (44%), followed by firearms/explosives (16%), poisoning (15%), jumping from a high place (10%), and jumping/lying in front of moving objects (7%). The distribution of suicide methods among dentists was closest to the general population; same order but fewer hangings and more use of firearms. For the other three health professions, poisoning was by far the most frequently used method, in 41% of physician, 64% of veterinarian, and 62% of pharmacist suicides. Among the remaining occupational groups, firearms were the most commonly used suicide method (37% of suicides among tax advisors/public accountants, 42% among lawyers, 60% among notaries), although those proportions should be interpreted with caution due to overall low numbers of suicide cases.

The four health professions were also analyzed stratified by gender, and there were some differences between males and females that were similar across groups: just like in the general population, women were more likely to use poisoning and less likely to use firearms (see supplement Table D).

4. Discussion

Among male health professionals included in this study, veterinarians were the only ones with a significantly increased suicide risk compared to the male general population. In fact, the risk was significantly lower for male physicians, indicating that there is no pattern of high suicide risk in male health professionals in Austria. In contrast, the suicide risk was significantly elevated for female veterinarians as well as

Table 3
Crude and age-adjusted suicide rates by occupation and gender, for a common time span (1998–2020).

	Men				Women				Male to female ratio ^b
	Suicides	Person-years	Crude rate/100,000	Age-adjusted rate/100,000 (95%CI) ^a	Suicides	Person-years	Crude rate/100,000	Age-adjusted rate/100,000 (95%CI) ^a	
Physicians	98	460 670	21.3	19.2 (15.4–23.0)	43	366 433	11.7	12.2 (8.6–15.9)	1.57
Dentists	12	56 581	21.2	16.6 (7.2–26.0)	6	39 420	15.2	17.1 (3.4–30.8)	0.97
Veterinarians	18	30 854	58.3	55.3 (29.8–80.1)	6	31 087	19.3	23.9 (4.8–43.0)	2.31
Pharmacists	6	24 462	24.5	20.8 (4.2–37.4)	8	91 591	8.7	10.1 (3.1–17.1)	2.06
Notaries	4	16 212	24.7	22.0 (0.4–43.6)	0	4 029	N/A	N/A	N/A
Tax advisors/public accountants	13	86 014	15.1	13.9 (6.3–21.5)	4	57 798	6.9	6.1 (0.1–12.1)	2.28
Lawyers	12	65 403	18.4	20.5 (8.9–32.1)	0	14 251	N/A	N/A	N/A
General population	14 500	58 209 357	24.9	25.1 (24.7–25.5)	4 330	58 221 629	7.4	7.5 (7.3–7.7)	3.35

^a Age-adjustment was based on the 2013 European Standard Population.

^b Based on age-adjusted rates/100,000.

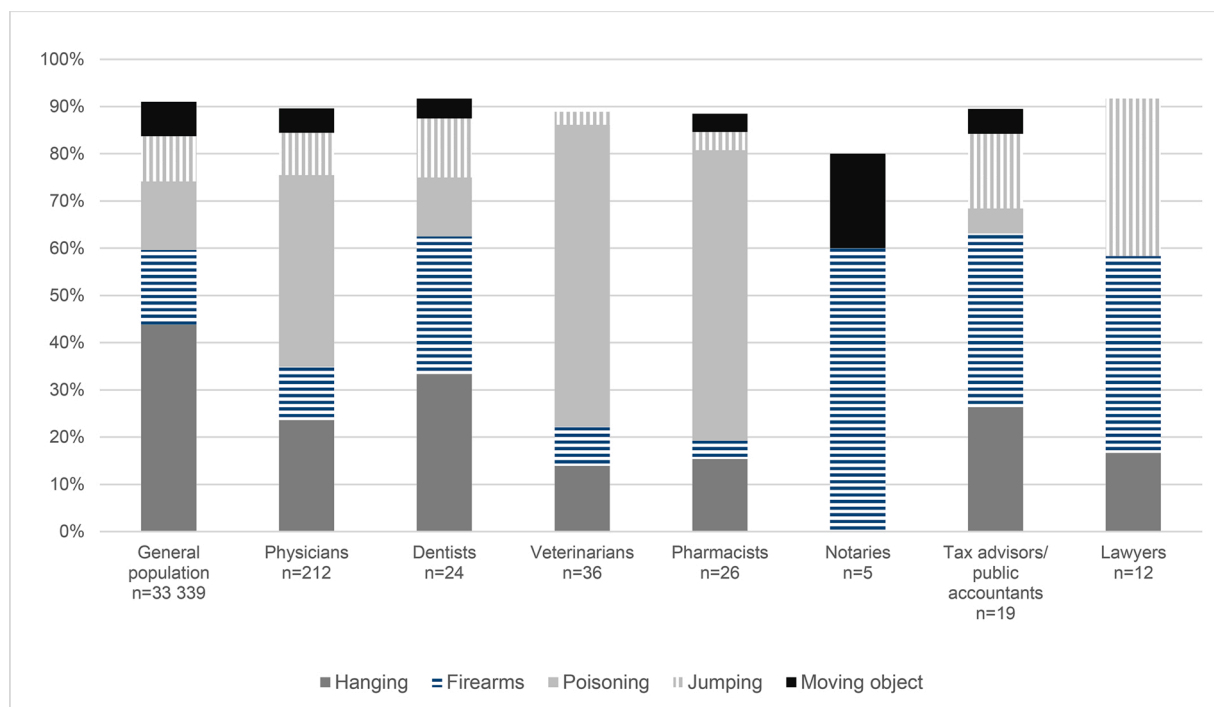


Fig. 1. Distribution of the five most frequently used suicide methods[‡] in the general population and across occupational groups, for the maximum time period of data availability[‡]

[‡] ICD codes used in determining suicide methods (ICD-9/ICD-10):

hanging/strangulation/suffocation (9530–9539/X700-X709), firearms/explosives (9550–9559/X720-X759), poisoning (9500–9529/X600-X699), jumping from a high place (9570–9579/X800-X809), jumping/lying in front of moving object (9581–9590/X810-X819)

[‡] Time period used for the general population was 1986–2020.

female physicians and pharmacists. The results also suggest a potentially higher suicide risk for female dentists, even though the SMR was not significant (probably due to low case numbers). These results are in line with several studies that found higher suicide risk in female health professionals but not in males (Irigoyen-Otiñano et al., 2022; Milner et al., 2016; Skegg et al., 2010; Petersen and Burnett, 2008) and also consistent with studies on elevated suicide risk for veterinarians of both genders (Witte et al., 2019; Milner et al., 2015; Platt et al., 2010). This indicates that the suicide risks for veterinarians and female health professionals does seem to differ from that of other high-skilled occupations who tend to have a lower suicide rate (Windsor-Shellard and Gunnell, 2019; Milner et al., 2013; Mustard et al., 2010), including the other high-skilled professions in our study.

Still, the evidence on suicide rates of male and female health

professionals remains mixed, and there are several potential factors to consider when looking at discrepancies. Geographic regions and countries likely account for some differences between study results, due to cultural factors and differences in training requirements (Weggemans et al., 2017), job characteristics and work strain. Data quality and the use of different outcome measures further contribute to inconsistent results with regard to occupational suicide risk.

Calendar time seems to be another important factor. This study also briefly analyzed changes in SMRs for physicians over three decades, and found a decrease in elevation of suicide risk among female physicians. Potential reasons might include changes in working conditions and associated strains over time, for example with regard to an increasing proportion of women in a male-dominated field. A decreased elevation of suicide risk is in line with the observation that more recent studies

found a lower level of elevation in suicide rates among health professions. A study from Britain (Roberts et al., 2013) compared occupational suicide rates for two different time periods and found highly elevated suicide rates for physicians, dentists, veterinarians and pharmacists of both genders for the time around 1980 (numbers for women tended to be severely underpowered in these earlier studies), and somewhat lower rates in the early 2000s (even though the rates for female veterinarians, pharmacists and physicians were still among the professions with the highest suicide rates for women). A review (Jones et al., 2016) on occupationally-linked suicides among dentists similarly concluded that their rates are likely “trending downwards”. There is not a lot of evidence on suicide risk among different occupational groups in Austria, but one older study calculated crude suicide rates for physicians during the time period of 1970–1997, which were elevated for both male and female physicians when compared to the general population (Sonneck and Wagner, 1996). By contrast, our study only found increased suicide rates for females during the time period of 1986–2020, so this could also support the notion that elevations in suicide risk in specific professional groups might change over time. Since this study also found a slight upwards trend in the SMR of male physicians over the last three decades, any future developments should be observed closely.

As expected, this study confirms poisoning as the most common suicide method among physicians, veterinarians and pharmacists, as has been found by other studies outside of the United States (Hawton et al., 2011; Skegg et al., 2010). Dentists are a notable exception, with a proportion of self-poisonings that was roughly equal to the general population. This result is consistent with findings from other studies (Hawton et al., 2011; Skegg et al., 2010; Arnetz et al., 1987) and might be due to the fact that access to lethal medicinal drugs is less common and their use less familiar among dentists. Veterinarians had the highest proportion of suicides by self-poisoning, which might be caused by easier access to lethal pharmaceutical products in high dosages and the frequent practice of euthanasia (Tomasi et al., 2019; Mellanby, 2005). Several studies suggest that suicide means are often chosen based on access and familiarity (Florentine and Crane, 2010; Hawton et al., 2000), so in case of veterinarians it could prove helpful to consider changes in regulations for distributing and storing drugs used in euthanasia (Nett et al., 2020).

In all three health professions where this was the dominant method of suicide, poisoning was more commonly used by women than men; the same holds true for the Austrian general population as well as other countries. Access to highly effective medication and expertise in toxicology turns poisoning into a more lethal method of suicide, which could partially explain the elevated suicide risk among female physicians (Schernhammer, 2005; Center et al., 2003). One study suggests that this may also result in a lower rate of suicide attempts among female physicians compared to the female general population (Frank and Dingle, 1999).

Differences in health outcomes of various occupations warrant the question if these disparities are mostly caused by an inherent professional risk or whether there could be a selection effect at work, e.g. when people with pre-existing risk factors for suicide are more likely to enter health professions. Plenty of risk factors within health professions have been considered as potential contributors to a higher suicide risk, like the emotional distress of confronting suffering and death, a heavy workload, and little control over work hours or (night) shift work in case of some physicians (Firth-Cozens, 1998). Easy access to controlled substances is not just relevant for choice of suicide method, but also a risk factor for the development of substance abuse disorders, which in turn increases the risk of depression and other mental illnesses (Merlo and Gold, 2008). Research from various countries suggests that physicians are disproportionately affected by depressive disorders (Bourne et al., 2015; Compton and Frank, 2011; Schwenk et al., 2008). There are studies with similar results for dentists (Mathias et al., 2005) and veterinarians (Schwerdtfeger et al., 2020). There is little evidence for a selection effect in health professions; one study (Brazeau et al., 2014) found that students enter medical school with mental health profiles that

are similar or better compared to other college graduates, suggesting that there is no elevated level of mental illness before entering the practice of medicine.

The strengths of this study are relatively long observation periods which allow for the study of suicide risk in smaller occupational groups, the inclusion of recent data and the combined analysis of several occupational groups for which other studies have shown increased suicide risk. To our knowledge, this is the first study to calculate SMRs and suicide rates for different professions in Austria by way of collating data from professional associations with cause-of-death-statistics. There are several limitations of this study that warrant consideration. 1) Suicide numbers for several occupational groups were quite low, and a lack of female suicides in two male-dominated professions (notaries and lawyers) meant that no SMRs or suicide rates for females were available for comparison. 2) The age range used in this analysis (<65 years) represents the typical period of working life and is most comparable to international studies, at the expense of excluding those who are still professionally active after the common retirement age of 65 years. This excluded group is most likely larger in the analyzed occupations than in the general population. The chosen age limit also entails a potential gender imbalance with regard to the inclusion of participants in early retirement. In Austria, women born before 1963 are able to retire sooner than men (with 60 years), although this affects high-skilled occupations to a lesser extent than the general population. 3) SMRs are likely to be underestimated due to data quality. For some deceased members of each professional association (see Table 1), the cause of death could not be identified (e.g. on account of misspellings or incomplete names, name changes due to marriage, or dying abroad). Consequently, suicide numbers can be assumed to be slightly higher than reported in this study, especially among deaths that date back further.

In conclusion, our findings provide further support for earlier evidence on an increased risk of suicide among veterinarians and female health care professionals. New findings of this study include the reduction in suicide risk elevation among female physicians and an estimation for suicide rates of several high-skilled occupations.

There is still much to explore about inconsistencies in the available evidence, for instance with regard to changes in suicide risk elevations over time and the underlying causes of suicide risk in health professions, especially among women. Based on our findings, it appears necessary to increase awareness of potentially elevated risks among those who provide professional support and (mental) health care to members of these occupations, and to implement targeted suicide preventions efforts.

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CRediT authorship contribution statement

Claudia Zimmermann: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Funding acquisition, Writing – original draft, Writing – review & editing. **Susanne Strohmaier:** Conceptualization, Methodology, Validation, Writing – review & editing. **Thomas Niederkrotenthaler:** Conceptualization, Writing – review & editing. **Kenneth Thau:** Conceptualization, Writing – review & editing. **Eva Schernhammer:** Conceptualization, Methodology, Investigation, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors have none to declare.

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Supplementary materials

Supplementary materials associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2023.115170](https://doi.org/10.1016/j.psychres.2023.115170).

References

- Aasland, O.G., Hem, E., Haldorsen, T., Ekeberg, Ø., 2011. Mortality among Norwegian doctors 1960-2000. *BMC Public Health* 11. <https://doi.org/10.1186/1471-2458-11-173>.
- Agerbo, E., Gunnell, D., Bonde, J.P., Bo Mortensen, P., Nordentoft, M., 2007. Suicide and occupation: the impact of socio-economic, demographic and psychiatric differences. *Psychol. Med.* 37, 1131. <https://doi.org/10.1017/S0033291707000487>.
- Arnetz, B.B., Horte, L.G., Hedberg, A., Malker, H., 1987. Suicide among Swedish dentists. A ten-year follow-up study. *Scand. J. Soc. Med.* 15, 243-246.
- Bamayr, A., Feuerlein, W., 1986. Incidence of suicides among medical doctors and dentists in Upper Bavaria. *Soc. Psychiatry* 21, 39-48.
- Bourne, T., Wynants, L., Peters, M., Van Audenhove, C., Timmerman, D., Van Calster, B., Jalbrant, M., 2015. The impact of complaints procedures on the welfare, health and clinical practise of 7926 doctors in the UK: a cross-sectional survey. *BMJ Open* 5, e006687. <https://doi.org/10.1136/bmjopen-2014-006687>. e006687.
- Brazeau, C.M.L.R., Shanafelt, T., Durning, S.J., Massie, F.S., Eacker, A., Moutier, C., Satele, D.V., Sloan, J.A., Dyrbye, L.N., 2014. Distress among matriculating medical students relative to the general population. *Acad. Med.* 89, 1520-1525. <https://doi.org/10.1097/ACM.0000000000000482>.
- Center, C., Davis, M., Detre, T., Ford, D.E., Hansbrough, W., Hendin, H., Laszlo, J., Litts, D.A., Mann, J., Mansky, P.A., Michels, R., Miles, S.H., Proujansky, R., Reynolds III, C.F., Silverman, M.M., 2003. Confronting depression and suicide in physicians: a consensus statement. *JAMA* 289, 3161. <https://doi.org/10.1001/jama.289.23.3161>.
- Compton, M.T., Frank, E., 2011. Mental health concerns among Canadian physicians: results from the 2007-2008 Canadian Physician Health Study. *Compr. Psychiatry* 52, 542-547. <https://doi.org/10.1016/j.comppsy.2010.10.002>.
- Davis, M.A., Cher, B.A.Y., Friese, C.R., Bynum, J.P.W., 2021. Association of US nurse and physician occupation with risk of suicide. *JAMA Psychiatry* 78, 651. <https://doi.org/10.1001/jamapsychiatry.2021.0154>.
- Eurostat, 2013. Revision of the European Standard Population - Report of Eurostat's task force - 2013 edition [WWW Document]. URL <https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-ra-13-028> (accessed 10.8.22).
- Firth-Cozens, J., 1998. Individual and organizational predictors of depression in general practitioners. *Br. J. Gen. Pract.* 5.
- Florentine, J.B., Crane, C., 2010. Suicide prevention by limiting access to methods: a review of theory and practice. *Soc. Sci. Med.* 70, 1626-1632. <https://doi.org/10.1016/j.socscimed.2010.01.029>.
- Frank, E., Biola, H., Burnett, C.A., 2000. Mortality rates and causes among U.S. physicians. *Am. J. Prev. Med.* 19, 155-159. [https://doi.org/10.1016/S0749-3797\(00\)00201-4](https://doi.org/10.1016/S0749-3797(00)00201-4).
- Frank, E., Dingle, A.D., 1999. Self-reported depression and suicide attempts among U.S. women physicians. *Am J Psychiatry*.
- Hawton, K., Agerbo, E., Simkin, S., Platt, B., Mellanby, R.J., 2011. Risk of suicide in medical and related occupational groups: a national study based on Danish case population-based registers. *J. Affect. Disord.* 134, 320-326. <https://doi.org/10.1016/j.jad.2011.05.044>.
- Hawton, K., Clements, A., Simkin, S., Malmberg, A., 2000. Doctors who kill themselves: a study of the methods used for suicide. *Qjm* 93, 351-357.
- Hem, E., Haldorsen, T., Gjerlø, W., Aasland, O., Tyssen, R., Vaglum, P., Ekeberg, Ø., 2005. Suicide rates according to education with a particular focus on physicians in Norway 1960-2000. *Psychol. Med.* 35, 873-880. <https://doi.org/10.1017/S0033291704003344>.
- Hill, G.B., Harvey, W., 1972. The mortality of dentists. *Br. Dent. J.* 132, 179-182.
- Hostettler, M., Minder, C., 2002. [Mortality of Swiss dentists], 112. *Schweiz. Monatsschr. Zahnmed.*, pp. 456-462.
- International Labour Office, 2022. ISCO - International Standard Classification of Occupations [WWW Document]. URL <https://www.ilo.org/public/english/bureau/stat/isco/> (accessed 1.1.23).
- Irigoyen-Otiñano, M., Castro-Herranz, S., Romero-Agüit, S., Mingote-Adán, J.C., Garrote-Díaz, J.M., Matas-Aguilera, V., López-Ordoño, G.J., Puigdevall-Ruestes, M., Alberich, S., González-Pinto, A., 2022. Suicide among physicians: major risk for women physicians. *Psychiatry Res* 310, 114441. <https://doi.org/10.1016/j.psychres.2022.114441>.
- Jones, L.M., Cotter, R., Birch, K.M., 2016. A review of occupationally-linked suicide for dentists. *N. Z. Dent. J.* 112, 39-46.
- Kölves, K., De Leo, D., 2013. Suicide in medical doctors and nurses: an analysis of the Queensland suicide register. *J. Nerv. Ment. Dis.* 201, 987-990. <https://doi.org/10.1097/NMD.0000000000000047>.
- Lee, K.C., Ye, G.Y., Choflet, A., Barnes, A., Zisook, S., Ayers, C., Davidson, J.E., 2022. Longitudinal analysis of suicides among pharmacists during 2003-2018. *J. Am. Pharm. Assoc.* 62, 1165-1171. <https://doi.org/10.1016/j.japh.2022.04.013>.
- Lorant, V., Kunst, A.E., Huisman, M., Bopp, M., Mackenbach, J., 2005. A European comparative study of marital status and socio-economic inequalities in suicide. *Soc. Sci. Med.* 60, 2431-2441. <https://doi.org/10.1016/j.socscimed.2004.11.033>.
- Mathias, S., Koerber, A., Fadavi, S., Punwani, I., 2005. Specialty and sex as predictors of depression in dentists. *J. Am. Dent. Assoc.* 136, 1388-1395. <https://doi.org/10.14219/jada.archive.2005.0052>.
- Mellanby, R.J., 2005. Incidence of suicide in the veterinary profession in England and Wales. *Vet. Rec.* 157, 415-417. <https://doi.org/10.1136/vr.157.14.415>.
- Merlo, L.J., Gold, M.S., 2008. Prescription opioid abuse and dependence among physicians: hypotheses and treatment. *Harv. Rev. Psychiatry* 16, 181-194. <https://doi.org/10.1080/10673220802160316>.
- Milner, A., Niven, H., Page, K., LaMontagne, A., 2015. Suicide in veterinarians and veterinary nurses in Australia: 2001-2012. *Aust. Vet. J.* 93, 308-310. <https://doi.org/10.1111/avj.12358>.
- Milner, A., Spittal, M.J., Pirkis, J., LaMontagne, A.D., 2013. Suicide by occupation: systematic review and meta-analysis. *Br. J. Psychiatry* 203, 409-416. <https://doi.org/10.1192/bjp.bp.113.128405>.
- Milner, A., Witt, K., Maheen, H., LaMontagne, A., 2017. Access to means of suicide, occupation and the risk of suicide: a national study over 12 years of coronal data. *BMC Psychiatry* 17. <https://doi.org/10.1186/s12888-017-1288-0>.
- Milner, A.J., Maheen, H., Bismark, M.M., Spittal, M.J., 2016. Suicide by health professionals: a retrospective mortality study in Australia, 2001-2012. *Med. J. Aust.* 205, 260-265.
- Mustard, C.A., Bielecky, A., Etches, J., Wilkins, R., Tjepkema, M., Amick, B.C., Smith, P.M., Gnam, W.H., Aronson, K.J., 2010. Suicide mortality by occupation in Canada, 1991-2001. *Can. J. Psychiatry* 55, 369-376. <https://doi.org/10.1177/070674371005500606>.
- Nett, R.J., Witte, T.K., Tomasi, S.E., Fowler, K.A., 2020. Storage of euthanasia solution as a factor in addressing veterinarian suicides. *J. Am. Vet. Med. Assoc.* 256, 1321-1322. <https://doi.org/10.2460/javma.256.12.1321>.
- Øien-Ødegaard, C., Hauge, L.J., Reneflot, A., 2021. Marital status, educational attainment, and suicide risk: a Norwegian register-based population study. *Popul. Health Metr.* 19, 33. <https://doi.org/10.1186/s12963-021-00263-2>.
- Petersen, M.R., Burnett, C.A., 2008. The suicide mortality of working physicians and dentists. *Occup. Med. Oxf.* 58, 25-29.
- Platt, B., Hawton, K., Simkin, S., Mellanby, R.J., 2010. Systematic review of the prevalence of suicide in veterinary surgeons. *Occup. Med.* 60, 436-446. <https://doi.org/10.1093/occmed/kqq044>.
- Rehkopf, D.H., Buka, S.L., 2006. The association between suicide and the socio-economic characteristics of geographical areas: a systematic review. *Psychol. Med.* 36, 145-157. <https://doi.org/10.1017/S003329170500588X>.
- Roberts, S.E., Jaremin, B., Lloyd, K., 2013. High-risk occupations for suicide. *Psychol. Med.* 43, 1231-1240. <https://doi.org/10.1017/S0033291712002024>.
- Rose, K.D., Rosow, I., 1973. Physicians who kill themselves. *Arch. Gen. Psychiatry* 29, 800-805.
- Schernhammer, E., 2005. Taking their own lives - the high rate of physician suicide. *N. Engl. J. Med.* 352, 2473-2476.
- Schernhammer, E.S., Colditz, G.A., 2004. Suicide rates among physicians: a quantitative and gender assessment (meta-analysis). *Am. J. Psychiatry* 161, 2295-2302.
- Schwenk, T.L., Gorenflo, D.W., Leja, L.M., 2008. A survey on the impact of being depressed on the professional status and mental health care of physicians. *J. Clin. Psychiatry* 4.
- Schwerdtfeger, K.A., Bahramsoltani, M., Spangenberg, L., Hallensleben, N., Glaesmer, H., 2020. Depression, suicidal ideation and suicide risk in German veterinarians compared with the general German population. *Vet. Rec.* 186. <https://doi.org/10.1136/vr.105430>.
- Shang, T.F., Chen, P.C., Wang, J.D., 2011. Mortality of doctors in Taiwan. *Occup. Med. Oxf.* 61, 29-32.
- Shimpo, H., Yokoyama, E., Tsurumaki, K., 1998. Causes of death and life expectancies among dentists. *Int. Dent. J.* 48, 563-570.
- Simpson, R., Beck, J., Jakobsen, J., Simpson, J., 1983. Suicide statistics of dentists in Iowa, 1968 to 1980. *J. Am. Dent. Assoc.* 107, 441-443.
- Skegg, K., Firth, H., Gray, A., Cox, B., 2010. Suicide by occupation: does access to means increase the risk? *Aust. N. Z. J. Psychiatry* 44, 429-434.
- Soe, M.M., Sullivan, K.M., 2006. Standardized Mortality Ratio and Confidence Interval [WWW Document]. URL <https://www.openepi.com/PDFDocs/SMRDoc.pdf>.
- Sonneck, G., Wagner, R., 1996. Suicide and burnout of physicians. *Omega J. Death Dying* 33, 255-263.
- Stallone, L., Doenges, T., Dik, B.J., Valley, M.A., 2013. Occupation and suicide: colorado, 2004-2006: occupation and Suicide. *Am. J. Ind. Med.* <https://doi.org/10.1002/ajim.22228> n/a-n/a.
- Statistics Austria, 2022. Causes of death [WWW Document]. URL <https://www.statistik.at/en/statistics/population-and-society/population/deaths/causes-of-death>.
- Stefansson, C.-G., Wicks, S., 1991. Health care occupations and suicide in Sweden 1961? 1985. *Soc. Psychiatry Psychiatr. Epidemiol.* 26, 259-264. <https://doi.org/10.1007/BF00789217>.
- Tomasi, S.E., Fechter-Leggett, E.D., Edwards, N.T., Reddish, A.D., Crosby, A.E., Nett, R.J., 2019. Suicide among veterinarians in the United States from 1979 through 2015. *J. Am. Vet. Med. Assoc.* 254, 104-112. <https://doi.org/10.2460/javma.254.1.104>.
- Torre, D.M., Wang, N.Y., Meoni, L.A., Young, J.H., Klag, M.J., Ford, D.E., 2005. Suicide compared to other causes of mortality in physicians. *Suicide Life. Threat. Behav.* 35, 146-153.

- Weggemans, M.M., van Dijk, B., van Dooijeweert, B., Veenendaal, A.G., ten-Cate, O., 2017. The postgraduate medical education pathway: an international comparison. *GMS J. Med. Educ.* 34 <https://doi.org/10.3205/zma001140>. Doc63.
- Windsor-Shellard, B., Gunnell, D., 2019. Occupation-specific suicide risk in England: 2011–2015. *Br. J. Psychiatry* 215, 594–599. <https://doi.org/10.1192/bjp.2019.69>.
- Witte, T.K., Spitzer, E.G., Edwards, N., Fowler, K.A., Nett, R.J., 2019. Suicides and deaths of undetermined intent among veterinary professionals from 2003 through 2014. *J. Am. Vet. Med. Assoc.* 255, 595–608. <https://doi.org/10.2460/javma.255.5.595>.
- Yaghmour, N.A., Brigham, T.P., Richter, T., Miller, R.S., Philibert, I., Baldwin, D.C., Nasca, T.J., 2017. Causes of Death of Residents in ACGME-accredited programs 2000 through 2014: implications for the learning environment. *Acad. Med.* 92, 976–983. <https://doi.org/10.1097/ACM.0000000000001736>.