

# The Impact of COVID-19 on the Chiropractic Profession: A Cross-Sectional Survey on opinions, professional changes, and personal hardships of U.S. Chiropractors

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## Research

**Keywords:** Chiropractic, COVID-19, Stress, Practice Characteristics, Immune System

**DOI:** <https://doi.org/10.21203/rs.3.rs-37901/v1>

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# Abstract

**Background :** Currently, there are few studies analyzing how COVID-19 has impacted the chiropractic profession. A recent paper, however, analyzed changes made to chiropractic practice by comparing the 7 different international regions represented by the World Federation of Chiropractic (WFC). In overall healthcare, there is limited research on specialty-based stress levels both before and during COVID-19. Our survey was conducted to collect self-reported data on how COVID-19 has affected U.S. doctors of chiropractic.

**Methods :** An electronic survey was sent to U.S. chiropractors nationwide via social media, email, and through Facebook groups. The survey collected personal and practice demographic information, practice protocols and changes made during COVID-19, chiropractic profession opinions/stances, information related to stress, and personal beliefs/opinions. Data was analyzed using descriptive statistics.

**Results :** 750 U.S. chiropractors responded. Just over half of respondents reported moderate levels of stress, and just over 30% reported severe levels due to a variety of reasons related to both personal and professional circumstances. The primary stressors were financial and business concerns. The highest stress levels were among employers responsible for others. A majority reported beliefs that the chiropractic profession should not advertise that spinal manipulation provides any immune system benefit. 13% of the respondents did believe chiropractors should be marketing immune benefits during this time. A shift toward telehealth was reported, with 18% adding it to their services.

**Conclusion :** Stress levels were high across the population. A range of opinions existed regarding spinal manipulation and immunity benefits. The majority reported there was not sufficient evidence to support such a belief; however, 13% of respondents believe that chiropractors should be marketing immune-enhancing benefits to the population. A logical next step would be to study why such beliefs persist. This information may be useful in better understanding how chiropractors have experienced the global effects of COVID-19 across the United States.

**Key Words :** Chiropractic; COVID-19; Stress; Practice Characteristics; Immune System

## Background

A novel coronavirus emerged from Wuhan, China in December of 2019. International travel and community spread allowed Coronavirus Disease 2019 (COVID-19) to quickly become a global pandemic in early 2020. (1) The first case of COVID-19 in the United States was confirmed in January 2020. By May 12, 2020 there were over 1.3 million confirmed cases in the U.S. along with more than 80,000 deaths. (2) This has increased subsequently.

The federal government offered guidance to limit spread (3), but governors of individual states were directed to make their own decisions regarding their response. (4) This led to heterogeneous responses across the U.S. with many but not all states implementing stay-at-home orders. (5) These orders have had profound economic effects, where even the healthcare sector has suffered. This sector of the U.S. economy has seen an 18% drop in healthcare spending, with multiple health systems reporting drops of 50% or greater in total revenue. (6)

The effect of the pandemic and its impact on chiropractors and their practices is not known. Occupational stress had already been a major problem across healthcare in general and notably within the chiropractic profession. (7) The objective of our study was to investigate the impact of COVID-19 on U.S. chiropractors and to assess whether a specific perspective on the nature of chiropractic care affects chiropractic attitudes, practice characteristics, and response to a global pandemic.

## Methods

### Survey Development

We created 28 questions that examined the impact of COVID-19 on the chiropractic profession. These questions were discussed among us to place them into final form. The questions and survey were pre-tested by a group of licensed chiropractors, who examined the questions for double meanings, sexist language, and clarity and concision. The revised questions were then used in the survey.

The survey was advertised via social media and email to large groups of doctors of chiropractic within the United States to research the impact of COVID-19 on personal lifestyle, professional decision-making, and attitudes from profession as a whole. The questions were related to demographic information (7 questions), general professional practice style (6 questions), COVID-19 changes to practice and lifestyle (12 questions), and opinions related to the chiropractic profession regarding immunity and philosophy (3 questions). The answers were collected via the following options: fill-in (n=5), single response questions (n=13), or multiple response

questions (n=10). Depending on the type of position held (administrator, educator, practitioner, etc.) some questions could be left unanswered.

The survey was open from April 19, 2020 to May 3, 2020, a total of 2 weeks. During this time, the pandemic was in a heightened state and shelter-in-place/stay-at-home orders were implemented across the majority of U.S. states. A disclaimer including the purpose of the survey and additional details was visible to all respondents at the beginning of the survey. The Parker University IRB approved this study, which was determined to be exempt under the Common Rule (45 CFR 46 reference).

## Participant Recruitment

750 doctors of chiropractic within the United States responded. Respondents were recruited through convenience sampling via survey links distributed digitally to multiple closed chiropractic Facebook groups and pages across the ideological spectrum of chiropractors. These Facebook communities spanned multiple regions within the United States and represented various pockets of the chiropractic profession. The following Facebooks groups or pages received the survey link: Aligned Chiropractors, All Natural Doctors, Amped Now, Awesome Chiropractors Around the Globe You & I Know, Chiropractic Equipment Sell/Trade, Chiropractic Forward, Chiropractic Mentor Members, Chiropractic, EBCN Diagnostic Imaging, Evidence Based Chiropractic Network, Foundation for Chiropractic Progress, Florida Female Chiropractors, Forward Rehab, Forward Thinking Chiropractic Alliance, Forward Thinking Women Chiropractors, Hospital Based Chiropractic, House Call Chiropractors' Forum, International Chiropractors' Association, Michigan Chiropractic Connection, Modern Chiropractic Marketing Group, NextGen ACA, Palmer 031, 173, and 154 Groups, as well 3 "yard sale" chiropractic groups. Three state associations (MI, VA, WA) reached out to us to ask permission to circulate to their members after being made aware of the survey via the Facebook notification. Links to the survey were also disclosed on personal Facebook profile pages of the authors, and snowball sampling occurred as respondents let others know about the survey.

## Analytic Methodology

Data was collected through Airtable (San Francisco, CA), an online data collection system. Questions were analyzed using descriptive statistics (counts, percentages, means and SD).

## Results

750 responses were obtained. The average age of participants was 41 (SD=12), with a range of 23-81. Table 1 shows the breakdown of ages in 6-year increments, while Table 2 shows the average years in practice of participants. Graduates from all U.S. chiropractic schools completed the survey. Participants licensed in all 50 states also took part in the survey; however, no chiropractors practicing in Delaware or Alabama completed the survey.

Table 1. Age breakdown.

Ages	Participants (n=750)	%
23-29	89	11.87%
29-35	206	27.47%
35-40	125	16.67%
40-46	113	15.07%
46-52	66	8.80%
52-58	48	6.40%
58-64	54	7.20%
64-69	35	4.67%
69-75	7	0.93%
75-81	1	0.13%

Table 2. Average years in practice.

Average Years in Practice	Entries (n=750)	%
Under 1 Year	60	8.00
1-3 Years	98	13.07
3-5 Years	92	12.27
5-10 Years	134	17.87
10-20 Years	179	23.87
20-30 Years	99	13.20
30+ Years	86	11.47
Unanswered	2	0.27

## Demographics

The highest number of respondents practice in the Midwest (see table 3). The majority of all respondents were located in areas with a population over 25,000, most commonly in an area with a population between 100,000- 250,000. State association membership was held by 59% of respondents, while only 47% reported membership in a national chiropractic association. When asked to classify their approach to chiropractic, 350 (47%) stated they were strongly evidence-based, 112 (15%) somewhat evidence-based, 221 (29%) both subluxation and evidence-based, 12 (1.6%) somewhat subluxation-based and 48 (6.4%) strongly subluxation-based. The strong majority did not feel that there was enough evidence to support claims of an immune system benefit related to spinal manipulation. Most (76%) agree that chiropractors should not advertise immune boosting effects of manipulation during the pandemic. However, 13% stated that chiropractors should advertise these effects, while 10% were unsure. The most common sources for guidance on professional decision-making were federal and state governments, local regulations, and colleagues.

Table 3. Geographic distribution of respondents

Region	States	Entries N=750	%
New England	CT, ME, MA, NH, RI, VT	48	6.40%
Mid-Atlantic	DE, MD, NJ, NY, PA, DC	88	11.73%
South	AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV	106	14.13%
Mid-West	IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, WI	262	34.93%
South-West	AZ, NM, OK, TX	79	10.53%
West	AK, CO, CA, HA, ID, MT, NV, OR, UT, WA, WY	163	21.73%
Unanswered		29	3.87%

Unselected States: Delaware, Alabama  
Note: some respondents selected multiple entries.

## Basic Descriptive Findings

- Stress

We asked about the amount of stress chiropractors were experiencing during the COVID-19 crisis. (Table 4) Just over half of respondents rated their stress level as moderate (ranging from 4-7 on an 11-point scale), while just over 17% experienced mild stress and just over 30% felt extreme stress levels. The average Stress level reported was 6/10. The most common causes of stress were business/employment concerns and financial/economic worries.

Table 4. Stress levels of respondents

STRESS LEVEL	Respondents N=750	%
Low Stress (0-3)	133	17.73%
Moderate Stress (4-7)	384	51.20%
Extreme Stress (8-10)	228	30.40%

The most significant reasons for experiencing stress were business/employment concerns (68%) and financial/economic worries (68%). These by far outweighed all other responses. However, other sources of stress included concerns for the patients who could not be seen (41%), the national political response to the pandemic (39%), and fear for the safety of friends and family (33%). (Table 5)

Table 5. Causes of stress

Cause of Stress	Respondents (n=750)	%
Child education changes	131	18
Concern for patients unable to be seen	305	41
Family dynamic stress	136	18
Financial/economic worries	507	68
Food/housing insecurity	45	6
General public's failure	185	25
Global suffering	149	20
Other healthcare provider's inability	129	17
Personal safety/health	158	21
Political response to virus	294	39
Safety/health of family and friends	247	33
Social isolation	155	21
Worry about staff/coworkers	178	24

When comparing average stress levels to type of position held (owner, associate, etc.), associate doctors of chiropractic, although reporting a mean level of stress of 5/10 (21.13%), had lower stress levels overall compared to those owning their own business or those working in unique settings such as administration, education, hospital care, etc. The most commonly reported stress level among practice owners was an 8/10 (20.46%), while the most commonly reported stress level among those working in administration, academia, hospitals, VA/DoD, etc. was an 8/10 (23.57%). Those in associate positions had the lowest levels of stress overall. (Figure 1, Table 6)

Table 6. Stress level by work role.

Stress Level	Owner (sole)	Owner group	Associate	VA/DOD	Multidisciplinary	Hospital	Educator	Administrative Role
0	1%	1%	1%	4%	1%	8%	4%	
1	2%	2%	3%		1%		4%	
2	7%	2%	3%	21%	4%	4%	4%	3%
3	7%	7%	7%	21%	12%	20%	9%	16%
4	5%	6%	11%	13%	10%	20%	9%	3%
5	14%	14%	21%	13%	7%	8%		3%
6	13%	18%	16%	4%	11%	4%	4%	19%
7	17%	14%	16%	14%	14%	8%	30%	24%
8	19%	24%	16%	8%	27%	12%	30%	22%
9	7%	5%	4%		7%	4%	4%	5%
10	6%	7%	2%		7%	8%		5%

- Practice Characteristics

We divided respondents into age groups based on generational categories: Silent Generation (born 1925-1945), Baby Boomers (1946-1964), Gen X (1965-1980), Millennials (1981-1996), and Gen Z (1997- present). Table 7 shows the breakdown based on this categorization.

Table 7. Generational categories

Generation	Birth Range	Current Age in 2020	n	%
Gen Z	1997-2012	23 and under	1	0
Millennials	1981-1996	24-39	399	53.4
Gen X	1965-1980	40-55	234	31.2
Baby Boomers	1946-1964	56-74	109	14.5
Silent Gen	1925-1945	75-95	1	0
Unanswered			6	0.8

Looking at locale of practice found the following: chiropractors located in rural settings accounted for 18.5% of respondents, those in small urban settings 26%, large urban settings 22%, and suburban settings just over 32%. Looking at this from a slightly different perspective, less than 2% practiced in locations with a population of 25,000 or less, 21% practiced in cities with populations between 25,001-100,000 people, nearly 31% in cities with populations between 100,001 and 250,000, and 19% based in cities with more than 250,000 people. Nearly 28% did not answer this question, however.

Nearly half of respondents were sole owners of their practice (47.3%), while just under 20% were owners in a group practice and another 20% were associates in a group practice. Other roles included administration (5%), hospital provider (3.5%), educator (3.2%), and VA chiropractor (3.3%). Nearly 67% of those who responded to this question cared for between 1-100 patients per week. Another 16% saw between 101-150 patients per week, and a small number saw more than that. A few responses to this question were questionable and potential outliers as some individuals claimed to see between 1150-1500 patients per week; we were unable to interpret if this was mistakenly reported as a total for an entire practice.

- Beliefs Toward Chiropractic and Immune Function

We looked at the relationship between national organizational membership and belief about whether spinal manipulation can benefit the immune system. Less than half of respondents were members of a national organization, while 61% said they were not or gave no response.

Of those who held membership, the vast majority was in the American Chiropractic Association (ACA). Approximately 20% of those claiming ACA membership felt that there is no proven benefit to the immune system from receiving spinal manipulation; 30% said immune benefits have not been proven but that future evidence might reveal more insight. Few in the ACA felt this has been completely proven; however, a larger group of respondents felt that there could be benefit, but there was not yet enough evidence to support any claims. All members of the International Chiropractic Association (ICA) sampled answered that there was an immune benefit, either proven or not yet proven. This is admittedly a small group overall, representing about 5% of our overall sample.

Overall, when asked if spinal manipulation could have immune-boosting effects, the largest set of responses to this question answered "Yes, but the current evidence is not sufficient to support claims." (Table 8)

Table 8. Belief concerning the immune benefit of chiropractic according to national association membership

Do you believe chiropractic/spinal manipulation can benefit the immune system?	No	No, but future evidence may reveal more insight	Unsure	Yes, but the current evidence is not sufficient to support claims	Yes, it has been proven by research	No Answer
ACA (n=320)	64 (20%)	96 (30%)	7 (2%)	129 (40%)	22 (6%)	2 (.6%)
ICA (n=36)				15 (42%)	21 (58%)	
No (n=256)	42 (16%)	38 (15%)	11 (4%)	109 (42%)	54 (21%)	2 (.7%)
No Answer (n=127)	8 (6%)	27 (21%)	11 (8%)	48 (38%)	29 (23%)	4 (3%)
Total N=749	114 (15%)	161 (21%)	29 (3%)	296 (39%)	126 (17%)	8 (1%)

We also investigated the relationship of immunity beliefs and the decision to open or close offices during the COVID-19 pandemic. Of those who believe chiropractic has a proven effect on immunity, the most popular choice was to remain fully open. For those who felt that current evidence was not substantial enough to claim a proven effect but that future evidence may support their position that spinal manipulation can benefit the immune system, the most common response was staying open with limited hours. Those who supported the answer that chiropractic does not have an effect on the immune system were more likely to choose to stay open with limited hours, but this group was more evenly spread across all the levels of office closure. This group was also more likely to choose to be fully closed than any other group. For those who were unsure about the effect of chiropractic on immunity, almost all stayed open to some degree, seeing patients for emergencies, with limited hours, or remaining fully open.

- Changes Made in Practice during COVID-19 And Chiropractic Approach

We asked what specific changes were made to respondent practices due to COVID-19. Respondents were able to select multiple options from the following: increased sanitation and overall cleanliness, limited number of people present within the building at all times, limited staff, use of telehealth, use of masks only, use of PPE (masks, gloves, etc.), or no changes at all. Of the 750 respondents, 178 chiropractors (23.7%) did not answer. Of those that answered, 517 (90.40%) reported an increase in sanitation and cleaning protocols, 394 (68.90%) reported limiting the number of people present in their building at any time, 254 (44.40%) reported limiting staff, 137 (24%) reported using telehealth services, 152 (26.6%) reported only using masks as PPE, and 205 (35.8%) reported using masks, gloves, etc. as PPE. Four people answered stating that no changes were made to practice (less than 1%).

568 respondents (75.7%) reported feeling comfortable with their current knowledge on PPE use. 78 (10.4%) reported not feeling comfortable while 84 (11.2%) reported feeling unsure. Recent graduates (from 1-5 years in practice) were most likely to believe there were no benefits for enhancing the immune system using chiropractic care. Older practitioners were more likely to feel that chiropractic care could improve immune function (Table 9).



Table 9. Belief concerning the immune benefit of chiropractic by years in practice

Do you believe chiropractic/spinal manipulation can benefit the immune system?	No	No, but future evidence may reveal more insight.	Unsure	Yes, but the current evidence is not sufficient to support claims.	Yes, it has been proven by research.	No Answer
Under 1 Year (N=60)	12 20.00%	18 30.00%	1 1.67%	18 30.00%	9 15.00%	2 3.33%
1-3 Years (N=98)	17 17.35%	37 37.76%	4 4.08%	29 29.59%	10 10.20%	1 1.02%
3-5 Years (N=92)	20 21.74%	27 29.35%	3 3.26%	35 38.04%	5 5.43%	2 2.17%
5-10 Years (N=134)	22 16.42%	28 20.90%	7 5.22%	52 38.81%	24 17.91%	1 0.75%
10-20 Years (N=179)	20 11.17%	27 15.08%	8 4.47%	76 42.46%	47 26.26%	1 0.56%
20-30 Years (N=99)	8 8.08%	12 12.12%	5 5.05%	47 47.47%	25 25.25%	2 2.02%
30 Years (N=86)	14 16.28%	15 17.44%	1 1.16%	48 55.81%	8 9.30%	0 0.00%
Unanswered (N=2)	0 0.00%	1 50.00%	0 0.00%	1 50.00%	0 0.00%	0 0.00%

- Telehealth Services and Chiropractic Approach.

Out of all 750 respondents, 137 (18.27%) reported that they offered telehealth services as a change to normal practice. Of those, the vast majority considered themselves to be “strongly evidence-based” (68.61%) in their approach to the chiropractic profession. Of the 48 who described themselves as “strongly subluxation-based”, only 6 (12.5%) reported using telehealth services. This result demonstrates a potential difference in practice style during COVID-19 based on professional stances. Of the 137 chiropractors who chose to offer telehealth services during the pandemic, 59.85% were Millennials born between 1981-1996. Gen X respondents were the second most likely population to use telehealth services (28.47%). Baby boomers only represented 10.95% of those offering telehealth services during this time. (Table 10)

Table 10. Telehealth use by belief

	n	%
Strongly evidence-based	94	68.61
Somewhat evidence-based	19	13.87
Both subluxation and evidence-based	15	10.95
Somewhat subluxation-based	1	0.73
Strongly subluxation-based	6	4.38
No Answer	2	1.46
Total participants	137	18.27

## Discussion

Stress has been documented in individuals and healthcare providers during the current pandemic (8). High incidences of anxiety and depression in healthcare workers during the pandemic have been reported. (9) Healthcare workers are at a significant risk of adverse mental health outcomes during the COVID-19 outbreak due to long hours, shortages of protective equipment, exhaustion, and isolation (10). The highest levels of stress in the surveyed population were attributed to financial/economic and business/employment concerns. This may be related to the widespread closing of businesses during stay-at-home orders in the U.S. Perceived stress rose in all doctors due to COVID-19 pandemic and quarantine., even in areas traditionally considered out-patient specialties with minimum stress. (11)

Our respondents experienced significant stress as well as depression and anxiety symptoms. The most severe symptoms were reported by 2.2 % to 14.5 % of all participants. The severity of mental health symptoms was influenced by age, gender, occupation, specialization, type of activities performed and proximity to COVID-19 patients. (12) Thirty percent of respondents reported severe levels of stress.

Most respondents were not able to keep their offices fully open; however, 193 (26%) reported they were fully open.

A majority of respondents sought out information concerning COVID-19 from government sources, at both federal and state level, as well as from their colleagues.

The highest stress levels seemed to be found in respondents who were responsible for employing others. Business owners and administrators showed the highest stress levels along with providers working in multidisciplinary practices. Interestingly chiropractors working in hospitals and VA/DoD settings rated the lowest levels of stress. This is of particular note as most of the existing data tracks stress in healthcare as it relates to occupational exposure. Chiropractors working in large health care settings would likely have a higher risk of exposure. Conversely, providers in this category might therefore have less stress related to employment, business or finances, the largest driver of stress in our study.

The highest percentage of those worried about business/employment were administrators. Surprisingly, percentages of those having financial/economic stress was relatively neutral across all positions. Financial/economic stress was lowest among VA docs, educators, and hospital doctors. VA docs cared more about political response than any other group and also indicated more worries regarding food. Administrators, hospital employees and owners of a group practice cared the most about staff/co-workers.

Child education changes, concern for patients unable to be seen, family stress, failure of general public to follow guidelines, safety of family/friends were relatively neutral/equal across the board. Global suffering ranked lower for most groups but more so for owners of group practice. Hospital and VA docs worried most about personal and safety health.

We looked carefully at respondents who believe that chiropractors should be advertising immune boosting effects during the pandemic. Chiropractors in this subgroup overwhelmingly believe that research has shown spinal manipulation improves immune function (70%). Surprisingly, 75% describe their approach to chiropractic as being evidence-based (when aggregating those who claimed to be *very, somewhat, or both evidence and subluxation-based*). This, in spite of well-circulated commentary, publication and guidance from national and international chiropractic organizations describing a lack of evidence to support such claims. (13, 14).

Members of the ICA were more likely to believe that chiropractors should advertise immune boosting effects. This may be due to the messaging contained in some of the public statements by this organization (15), or the messages may be designed to soften the language to appeal to this segment of the organization's membership. ACA members were far more likely to not favor such advertising. Respondents who are not members of national organizations and those who chose not to answer concerning affiliation were more likely to oppose advertising immune effects of spinal manipulation.

## Limitations

As with most survey questionnaires, the primary limitation of this study is the response rate and potential bias. All questions in this survey did not require mandatory response. Respondents were able to answer questions that related to them and ignore those that did not or those they felt uncomfortable answering due to personal or professional opinion. Because of this, the participants that chose to answer or not answer a particular question could impact the results. In addition, a few of the questions had a higher non-response rate, which could have impacted the results as well.

Our study was advertised via social media pages and shared both publicly and privately through email, Facebook pages, direct messages, and through several chiropractic organizations. Because of this lack of complete inclusion, there is a potential degree of coverage error, as not all U.S. chiropractors received information about this survey. A potential way to avoid this in future studies would be a partnership with state associations to ensure the survey is shared to as many U.S. chiropractors as possible.

Far more respondents were members of the ACA compared to those from the ICA. With such a small sample from the ICA we cannot state that responses are representative. In all cases, we do not know how representative our sample is nor how it compares to the national population of chiropractors. An added limitation of sampling bias is that the majority of participants were either Millennials or members of Gen X (84.4%). This is more than likely due to the fact that this survey was promoted via social media platforms digitally.

Our survey platform was Airtable, which does not allow us to limit the amount of entries a participant may provide since the survey was not administered to specific email addresses or ip addresses.

The final limitation is that the data collected from this study came from self-reported data. This form of data requires the researchers to assume participants are being honest in their responses.

## Conclusion

The COVID-19 pandemic has led to significant stress on chiropractors in the U.S. The most commonly reported causes of stress were business/financial and employment/job related. Over half of the respondents reported moderate stress, with over 30% reporting severe stress. Most respondents (74%) responded that their practices were not fully open and 18% reported providing telehealth services.

A majority of those surveyed responded that there is not sufficient evidence to show an immune benefit to spinal manipulation; however, 17% felt that evidence has shown that spinal manipulation improves immune function. Approximately 13% of respondents believed that chiropractors should be advertising immune-boosting effects during the pandemic. Participants who hold the opinion that chiropractic care has been proven to affect the immune system were most likely to remain fully open during the COVID-19 pandemic. Those who believe chiropractic does not affect the immune system were more likely to close than any other group. Most chiropractic offices made changes to their daily office procedures in order to provide a safe office environment. Increasing overall sanitization and cleanliness was the most adopted change, while limiting the number of people present in the office at one time was the second most popular accommodation.

While we have hard data on chiropractors' responses to COVID-19, we do not know why they chose the answers they gave. Future work should include conducting focus groups with representative members of the survey to better tease out why they stayed open or closed, why they believe or do not believe in the immune effects of chiropractic care and so on.

## Abbreviations

ACA: American Chiropractic Association

ICA: International Chiropractors Association

WFC: World Federation of Chiropractic

COVID-19: Coronavirus Disease 2019

## Declarations

### Ethics approval and consent to participate:

This project was approved by the Parker University Institutional Review Board as exempt under 45CFR46 The Common Rule.

### Consent for publication:

Not applicable.

### Availability of data and materials:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Competing interests:

The authors declare that they have no competing interests.

### Funding:

Not applicable.

### Authors' contributions:

SN was a major contributor to study design, participated in data collection and analysis, and was a major contributor in writing the manuscript. RD was a major contributor to study design, participated in data collection and analysis, and was a major contributor in writing the manuscript. AM was a major contributor to study design, participated in data collection and analysis, and was a major contributor in writing the manuscript. DL was a major contributor to study design, participated in data collection and analysis, and was a major contributor in writing the manuscript.

### Acknowledgements:

The authors thank Dr. Katie Pohlman for assistance in organizing data used to analyze and develop two tables for this manuscript.

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## Figures

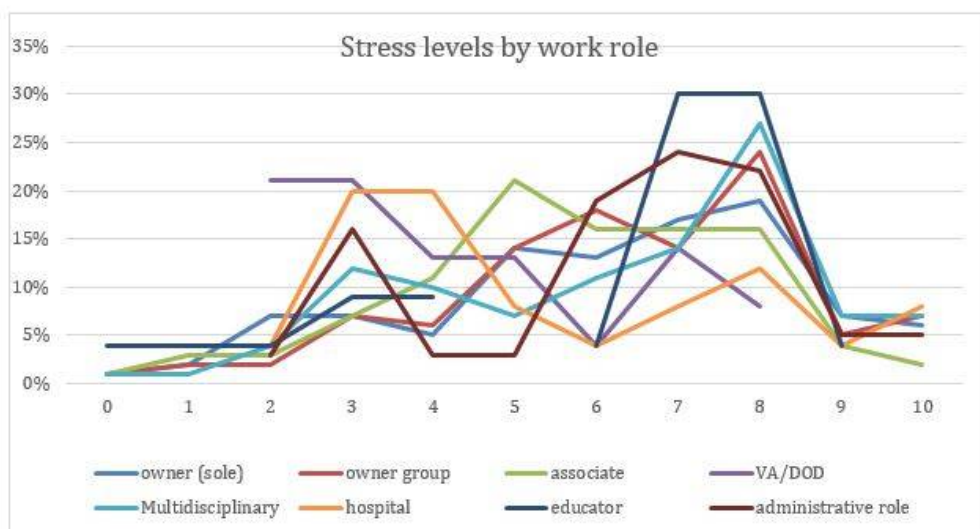


Figure 1

Stress levels by work role.

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