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Academic performance and attitudes of dental students impacted by COVID-19

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Abstract

Objectives: Previous studies only focused on attitudes and behaviors of US dental students without examining direct effects of the COVID-19 pandemic on academic performance. This study examined effects of COVID-19 pandemic on dental students' academic performance, self-reported attitudes, behavior, and service utilization. We hypothesized that the pandemic provided more beneficial learning environments.

Methods: This mixed study design implemented a cross sectional survey with retrospective extraction of students' academic grades. A survey of 274 predoctoral students assessed self-reported attitudes/behaviors and service utilization. First year Doctor of Dental Medicine (DMD1) 2021–2024 students' academic performance data were extracted. Independent *t*-test and chi-square crosstab analyses were conducted assessing differences between pre-COVID and post-COVID cohorts.

Results: Participants' academic grades identified statistically significant associations between pre-/post-COVID grades in five of 12 DMD1 courses. Grade percentages identified increased average grades in four of 12 DMD1 courses, with one of 12 courses demonstrating decreased grade percentage. Half of survey participants were female ($n = 37/72$, 51.4%), 79.2% were 25–34 years old, and 44.4% ($n = 32$) were DMD 2024. About 1/5 (20.8%, $n = 15$) sought counseling/therapy. Students agreed staying home allowed more time to study (66.7%, $n = 48$), while 59.2% ($n = 42$) reported increased financial concerns. A majority reported lacking in-person group studying decreased performance, and 55.6% ($n = 40$) reported feeling depressed.

Conclusion: Students performed better overall in courses delivered remotely with clinical application and team-based engagement. Students performed equally overall; however, the majority had concerns regarding finances, group studying, and mental health challenges. This highlights the need for more readily available resources at institutions.

KEYWORDS
attitudes, dental education, knowledge, practice academic test performance

1 | INTRODUCTION

The COVID-19 pandemic continues to have a widespread effect on all areas of our lives. It is important to examine challenges that have risen from this event to identify future changes and explore how we responded during such an unprecedented time. While the world still attempts to find the best balance of precaution and science, the impact to our educational environments continues to be challenged and felt widespread. Students previously familiar with interactive, face-to-face experiences had to rapidly adapt to remote, online learning. Students had to manage physical isolation as they faced stay-at-home and physical distancing requirements implemented by the school and county. Faculty had to engage students through innovate instructional methods. Moreover, faculty had to utilize home-based offices and face challenges such as poor internet and distractions while delivering curriculum. Multiple studies have shown that there were increased reports of depression, anxiety, and stress among dental students during the pandemic.[1,2] These studies suggest that dental program's resources and strategies may need be adjusted to address mental health concerns among dental students.

During the pandemic in the United States, dental education programs, which typically involve a rigorous week full of didactic and technical curriculum, were initially faced with completely remote learning methods. After several months, most programs moved to a hybrid educational approach. The return to hybrid learning was necessary to allow time for clinical experiences – a mandatory component of the DMD degree. Previous studies identified that dental students experienced increased levels of stress and felt their clinical education suffered because of COVID-19.[2,3]

Programs can use multiple methods to determine outcomes from this unexpected change by using a multi-pronged analysis of student's academic scores and their simultaneous utilization of campus resources and attitudes.[4] If programs identify multiple trends across important themes such as dental ethics, or student's perceptions of academic integrity, programs may make significant changes to improve performance in the future. The impact of these findings to successful completion of the DMD program and transition to practice may also be related to a student's mental health status.[5] As such, programs should be able to readily adapt to changes specific for students' academic and mental success. This study examined the impact of COVID-19 on dental students' academic performance, self-reported attitudes, behavior, and utilization of services. We hypothesized that the pandemic provided a more beneficial learning environment for predoctoral dental students.

2 | METHODS AND MATERIALS

This study was approved by the institutional review board at WesternU (X21/IRB/023). The office of Academic Affairs deployed the survey and collected all data. The data were deidentified and securely shared with the authors for analysis. A mixed study design was conducted to assess the impact of COVID-19 on dental student academic performance, student attitudes, and behavior at Western University of Health Sciences (WesternU) College of Dental Medicine (CDM). The mixed study design included a cross-sectional survey with retrospective data extraction of students' academic grades. Academic performance was examined through the analysis of academic grades across four cohorts of predoctoral students DMD 2021 through DMD 2024 using the Fall and Spring semester for each cohort. Students' attitudes and behavior were examined through Qualtrics web-based surveys.

2.1 | Participant characteristics

WesternU is a private, nonprofit health sciences university located in Pomona, California. WesternU CDM is accredited by the Commission of Dental Accreditation and offers a DMD degree through its 4-year program. It currently has 284 dental students enrolled; 274 students are predoctoral, and 10 students are enrolled in the International Dentist Program (IDP). IDP students were excluded from this study because the IDP program offers a different course load as compared to the traditional DMD program. CDM provides general dentistry comprehensive services through on-campus dental clinics and off-campus community clinics. During COVID-19, students continued to provide dental care with limited capacity for emergency services. Once reopened in July 2020, full services resumed with a reduced clinical footprint. In August 2021, on-campus dental clinics resumed at full capacity.

2.2 | Academic grades

Academic grade data were collected from all four cohorts of predoctoral students. Students from the graduating class of 2024 received their Year 1 education after the start of the COVID-19 pandemic and were identified as "post-COVID." Students from the graduating class of 2021, 2022, and 2023 received their Year 1 education before the start of COVID-19 and were identified as "pre-COVID." Courses for the Year 1 Fall term include molecular and cellular basis of medicine, gross anatomy, introduction to disease, immunity and therapeutics, essentials of clinical dentistry (ECD)

I, and service learning (SL) I. Courses for the Year 1 Spring term include neuroscience system, musculoskeletal system, head and neck anatomy, ECD II, behavioral science and dentistry (BSD), blood and lymphatic system (BL), and SL II.

2.3 | Survey on attitudes and behavior

The study consisted of a pilot survey and a follow-up survey. Due to the pilot nature of the study, the reliability and validity of the proposed questionnaire have not been externally validated. We invited predoctoral students to complete the pilot Qualtrics survey from April 23 to May 10, 2021. This close-ended anonymous survey consisted of 24 multiple-choice and three free-response questions. The 24 multiple-choice questions consisted of six main domains: academic concerns, transportation concerns, psychosocial effects, clinical concerns, board exam preparation, and graduation/employment concerns. The multiple-choice questions were scored on a five-point Likert scale (e.g., 0 = strongly disagree, 1 = disagree, 2 = neither agree/disagree, 3 = agree, 4 = strongly agree).

A follow-up survey was developed with the intention of gathering additional information as discovered from the pilot survey. We invited predoctoral students to complete the follow-up Qualtrics survey from June 28 to July 15, 2021. The close-ended anonymous survey contained 15 multiple-choice questions and one free-response question. The multiple-choice questions were scored on the same five-point Likert scale as the pilot survey. Common themes from the Qualtrics questions were analyzed by NVivo (Release 1.0) for development of visual word cloud graphics (Table 1). Compared to the pilot survey, the "board exam preparation" domain was removed, and "relationships" domain introduced. The domain "psychosocial effects" was renamed to "psychosocial concerns." One question from the previous "board exam preparation" domain was adapted into the "academic concerns" domain in the follow-up survey.

2.4 | Data analysis

After closure of the survey window, data were collected and exported for analysis using the SAS software for Windows version 9.4 (Cary, North Carolina, USA). Prior to data analysis, all negatively worded questions were reverse-scored for consistency. Two outcomes were assessed in this study: academic grades and self-reported student attitudes and behaviors. Descriptive statistics were presented as means and standard deviations for continuous variables, along with frequencies and proportions for categorical variables.

TABLE 1 Change of wording from pilot study to follow-up study

Pilot study	Follow-up study
Since the pandemic started, I have had more time to study for my classes.	I have more time to study during the pandemic.
CDM has provided me with adequate time and resources to prepare for the INBDE.	CDM has provided me with adequate time and resources to prepare for the mock INBDE.
Since the pandemic started, I have had more time to study for my classes.	I have more time to study due to less need for regular transportation/commute.
	"The lack of in-person group studying made it more difficult for me to study during the pandemic."
	"My family has supported me emotionally during the pandemic."
	"I have felt feelings of depression during the pandemic."
	"I have felt overwhelmingly stressed during the pandemic."
	"I would have benefitted from seeing a therapist during the pandemic."
	"I have enough time for lunch break."

Abbreviation: CDM, College of Dental Medicine.

An independent *t*-test was conducted to assess if there was any statistical significance between the pre- and post-COVID groups. The basis of *t*-test was based on the distribution of data. We aimed to identify if there was any statistically significant difference between the pre- and post-Covid group. Therefore, an independent *t*-test is an appropriate choice to test if there was a statistically significant difference on continuous variables between two groups.

Chi-square crosstab analyses were conducted to assess if there was any statistically significant association between categorical variables and pre-/post-COVID cohorts. Fisher's exact tests were also conducted if the expected cell count was less than 5. All statistical tests were two-sided. p-Values < 0.05 were considered statistically significant.

3 | RESULTS

A total of 351 participants were included in the analysis of academic performance. The distribution of cohorts was roughly equal with approximately 70 participants from each class (five classes in total). More than half of the participants were female (50.7%, $n = 178$). Table 2 presented

TABLE 2 Students' academic performance pre- and post-Covid (p-value < 0.05)

	Pre-Covid (DMD 2021–2023)	Post-Covid (DMD 2024)	p-Value
Gross anatomy grade			<0.0001
A	143 (54%)	13 (18.6%)	
B	84 (31.7%)	48 (68.6%)	
C	30 (11.3%)	8 (11.4%)	
F	8 (3%)	1 (1.4%)	
Frequency missing = 16			
Neuroscience grade			0.0331
A	154 (55.4%)	27 (39.1%)	
B	83 (29.9%)	24 (34.8%)	
C	35 (12.6%)	17 (24.6%)	
F	6 (2.2%)	1 (1.5%)	
Frequency missing = 4			
ECD II grade[a]			0.0498
A	111 (53.1%)	46 (69.7%)	
B	94 (45%)	20 (30.3%)	
C	4 (1.9%)	0 (0%)	
Frequency missing = 5			
Blood and lymph grade			0.0037
A	240 (86.3%)	69 (98.6%)	
B	38 (13.7%)	1 (1.4%)	
Frequency missing = 3			
Service learning II grade[a]			0.0188
A	183 (87.6%)	68 (98.6%)	
B	22 (10.5%)	1 (1.5%)	
C	4 (1.9%)	0 (0%)	
Frequency missing = 2			
Average cohort grade percent (out of 100)			
Preadmission science GPA	3.17 ± 0.31	3.09 ± 0.31	0.0522
Gross anatomy grade percentage	89.01 ± 7.82	85.57 ± 5.37	0.0006
ECD I grade percent	90.95 ± 3.26	91.85 ± 2.46	0.0125
BSD grade percent[a]	98.66 ± 1.37	99.1 ± 1.12	0.0158
Blood and lymph grade percent	93.46 ± 3.03	95.65 ± 2.41	<0.0001
Service learning II grade percent[a]	93.68 ± 4.37	95.91 ± 2.19	<0.0001

Abbreviations: BSD, behavioral science and dentistry; CDM, College of Dental Medicine; ECD, essentials of clinical dentistry; GPA, Grade Point Average.

[a]The DMD 2023 cohort was excluded from the "pre-COVID" group because a hybrid curriculum was used with DMD 2023 during this time. The DMD 2023 ECD II, BSD, and SL II courses had started in person, then switched to an online teaching environment.

the analysis results of academic performance pre- and post-Covid. There was a statistically significant difference in grades of Gross Anatomy Grade ($p = 0.0006$); Neuroscience Grade ($p = 0.0331$) BL Grade ($p < 0.001$); ECD II Grade ($p = 0.0498$); BSD ($p = 0.0158$); and SL II Grade ($p = < 0.001$). Examination of grades by percentages (out of 100) demonstrated a statistically significant increase in the average grade in DMD 5050 ECD I Grade percent (90.95 and 91.85 for pre- and post-Covid, $p = 0.0.125$); DMD 5155 BSD Grade percent (98.66 vs. 99.1 for pre- and post-Covid, $p = 0.0158$); DMD 5175 BL Grade percent (93.46 vs. 95.65 for pre- and post-Covid, $p < 0.0001$); and DMD 5199 SL II Grade percent (93.68 vs. 95.91 for pre- and post-Covid, $p < 0.0001$). One class demonstrated a statistically significant decrease: DMD 5030 Gross Anatomy Grade percentage (89.01 and 85.57 for pre- and post-Covid, $p = 0.0006$).

A total of 72 participants (response rate of 20.5%) completed the follow-up survey. Half of the participants were female ($n = 37$, 51.4%), 79.2% of participants were between age 25 and 34 years, and 44.4% ($n = 32$) of the participants

were from the DMD 2024 cohort. Additional demographic detailed information is presented in Table 3.

Table 3 also presented students' view on the effect of pandemic on mental health and academic-related topics. About one-fifth (20.8%, $n = 15$) sought counseling or saw a therapist during the pandemic. Students agreed or strongly agreed that staying at home allows more time to study (66.7%, $n = 48$); had less transportation issue (59.7, $n = 43$); 59.2% ($n = 42$) reported having more financial concerns; and 68.1% ($n = 49$) reported having family support during the pandemic.

There are also negative views on the impact of pandemic. More than half (52.8%, $n = 38$) reported that lacking group studying in-person made it more difficult to study during the pandemic; Zoom cannot replace in person teaching (61.1%, $n = 44$); 55.6% ($n = 40$) felt depressed; 63.9% ($n = 46$) felt stressed; 52.1% ($n = 37$) felt there will be delays in completing my clinical requirements. Note that 27.8% felt that CDM has provided adequate time and resources to prepare for the mock Integrated National Board Dental Examination (INBDE). Surprisingly, 67.5% ($n = 48$) reported that they do not have enough time for a lunch break.

4 | DISCUSSION

To our knowledge, this is the first study to examine the direct impact of COVID-19 on academic performance, student attitudes, and behavior in US dental schools. This study found that more than half of dental student participants felt depressed (55.6%) or overwhelmingly stressed (63.9%) during COVID-19. At the same time, most dental students (79.2%) did not receive counseling or see a therapist during COVID-19. Dental schools must consider ways to address this mental health "treatment gap" – the difference between the number of students that need care and those that receive care. Disconcertingly, previous literature demonstrates that the perception of a dental students' mental health status went unrecognized, with less than half of dental school faculty members able to identify that a student was overly stressed during COVID-19.[6] As dental schools continue to adapt to online curricula during the time of a pandemic, educators and administrators must consider potential factors that could influence students' academic success, such as mental health, financial concerns, lack of in-person group studying, and time for lunch breaks.[1,5] As in previous studies, understanding the variability of wellness and potential impact to success in a program are important factors to consider.

As dental students face a multitude of changes during the pandemic, it is important to consider COVID-19's lasting impacts on dental education, in addition to students' learning styles. Even though most dental students felt concerned with delays in completing clinical requirements (52.1%), only 35.2% agreed that they were concerned about graduating in time. These findings are consistent with a recent study that reported that students were more concerned with clinical experiences affected by the pandemic as opposed to their future academic endeavors postgraduation.[3] This brings up an interesting discussion as to whether there has been an increase in demand and applicants to residency programs such as Advanced Education in General Dentistry or General Practice Residency since the pandemic.

While dental students faced many novel challenges during COVID-19, there were several benefits offered from the transition to online curricula. For instance, 66.7% of dental students reported more time to study during the pandemic, and 59.7% reported having less transportation issues/concerns since the start of the pandemic. Similar findings were reported by Amir et al., where they reported that most dental students surveyed felt the pandemic offered them more time to study.[7] This is likely because in-person lectures have switched over to online platforms, such as Zoom. However, most dental students (61.1%) agreed or strongly agreed that online Zoom lectures did not adequately replace in-person lectures. One student stated, "I need engagement with my professors and have a very, very hard time concentrating in Zoom lectures due to the lack of educational environment. The pandemic and heavy online learning has greatly affected my academic performance, and I feel as if I am not actually in dental school." More than half (52.8%) of dental students reported that it was more difficult to study during the pandemic due to the lack of in-person group studying.

Notably, 67.6% of dental students disagreed that they had sufficient time for a lunch break. From July 2020 to July 2021, DMD 2021 and DMD 2022 students were scheduled to see patients from 8 a.m. to 5 p.m. with no formal lunch break. One student stated, "[My] greatest challenge was getting more clinical experience as a D3, but also losing lunch time can be especially draining when you are required to attend clinic all sessions every day." The DMD 2023 and DMD 2024 cohorts also faced similar challenges with balancing lunch breaks and preclinical course schedules. According to one student, "[The] time constraint between when lecture classes and laboratory classes start has been challenging. I never have a lunch during laboratory days because I spend the entire time driving to campus."

As mentioned earlier, the class of 2024 (post-Covid cohort) performed statistically significantly better in ECD I, BSD, BL, and SL II courses. However, the same cohort performed statistically significantly worse in the Gross Anatomy course. There were no statistically significant

TABLE 3 Summary of survey participants and survey responses

	Frequency ($n = 72$)	Percentage
Gender		
Female	37	51.4%
Male	34	47.2%
Prefer not to disclose	1	1.4%
Age		
18–24 years old	11	15.3%
25–34 years old	57	79.2%
35–44 years old	4	5.6%
Class year		
DMD 2021	8	11.1%
DMD 2022	15	20.8%
DMD 2023	17	23.6%
DMD 2024	32	44.4%
Did you seek counseling or see a therapist during the pandemic?		
Yes	15	20.8%
No	57	79.2%
I have more time to study during the pandemic.		
Agree or strongly agree	48	66.7%
Neutral	13	18.1%
Disagree or strongly disagree	11	15.3%
I believe online Zoom lectures do not adequately replace in-person lectures.		
Agree or strongly agree	44	61.1%
Neutral	8	11.1%
Disagree or strongly disagree	20	27.8%
I have had less transportation issues/concerns since the pandemic started.		
Agree or strongly agree	43	59.7%
Neutral	20	27.8%
Disagree or strongly disagree	9	12.5%
The lack of group studying in-person made it more difficult for me to study during the pandemic.		
Agree or strongly agree	38	52.8%
Neutral	15	20.8%
Disagree or strongly disagree	19	26.4%
My family has supported me emotionally during the pandemic		
Agree or strongly agree	49	68.1%
Neutral	14	19.4%
Disagree or strongly disagree	9	12.5%
I have felt feelings of depression during the pandemic.		
Agree or strongly agree	40	55.6%
Neutral	9	12.5%
Disagree or strongly disagree	23	31.9%
I have felt overwhelmingly stressed during the pandemic.		
Agree or strongly agree	46	63.9%
Neutral	12	16.7%
Disagree or strongly disagree	14	19.4%

(Continues)

TABLE 3 (Continued)

	Frequency ($n = 72$)	Percentage
I have enough time for a lunch break.		
Agree or strongly agree	21	29.6%
Neutral	2	2.8%
Disagree or strongly disagree	48	67.6%
Frequency missing = 1		
I am not confident in my clinical skills/ability to deliver quality care.		
Agree or strongly agree	23	32.4%
Neutral	19	26.8%
Disagree or strongly disagree	29	40.9%
Frequency missing = 1		
I am concerned there will be delays in completing my clinical requirements.		
Agree or strongly agree	37	52.1%
Neutral	13	18.3%
Disagree or strongly disagree	21	29.6%
Frequency missing = 1		
I am worried about graduating on time.		
Agree or strongly agree	25	35.2%
Neutral	12	16.9%
Disagree or strongly disagree	34	47.9%
Frequency missing = 1		
Since the start of the pandemic, I have less financial concerns.		
Agree or strongly agree	13	18.3%
Neutral	16	22.5%
Disagree or strongly disagree	42	59.2%
Frequency missing = 1		
CDM has provided me with adequate time and resources to prepare for the mock INBDE.		
Agree or strongly agree	20	27.8%
Neutral	29	40.3%
Disagree or strongly disagree	23	31.9%

Abbreviations: CDM, College of Dental Medicine; DMD, Doctor of Dental Medicine; INBDE, Integrated National Board Dental Examination.

differences in other courses. When analyzing average percentage per cohort in the DMD1 year, students performed statistically better in the spring courses, BSD, BL, and SL II. This may be because students were able to adapt to the remote learning environment, or perhaps that these courses utilized a more interactive approach with breakout rooms and engaging styles. While these courses had overall higher average percentage per cohort, like Mukhtar et al., it is difficult to assess the true academic integrity behind the scores through virtual examination software.[8,9] One student mentioned they were able to "spend more time studying due to less time dedicated to traveling."

As to the poor performance in the gross anatomy course, when in-person, this course involves students checking out a "bone box", which contains a variety of human skeletal bones. In addition to lecture on PowerPoints, students are divided into small groups and work together, utilizing their bone box to answer assignment questions. In previous years, dental students were also able to utilize Anatomage virtual dissection tables as a study resource. It is possible the switch to an online environment contributed to making group studying and observing 3D details more difficult. Another possibility is decreased motivation after completion of the rigorous coursework. Several students reported a lack of motivation during virtual learning. For instance, one student mentioned experiencing "lack of personal connection with faculty and peers… therefore lack of motivation." A study by Hung et al. found that the pandemic can exacerbate stressors, including feelings of, "loneliness" and, "anxiety," which can in turn lead to lack of motivation and or depression.[2] Regarding improved academic performance in the ECD I preclinical course, ECD I relies heavily

on simulation laboratory projects and didactic exams. Perhaps the greater flexibility for students to study at home helped the post-COVID cohort excel with written exams in ECD I. Regarding BSD, the course relied heavily on small group sessions for students to practice patient interviews with one another. The post-COVID cohort may have performed better in BSD because they felt more comfortable and relaxed in an online environment. For example, one student shared that they felt "less anxiety when I am away from other classmates," which could make the BSD breakout rooms more conducive to online learning. In terms of the better academic performance for the BL course, the course relies heavily on information presented on lecture slides and RealizeIt online platform. Students may have benefitted from this curriculum in an online setting due to the ability to study at their own time. SL II developed new methods to engage students using breakout sessions, community outreach events, and shared group assignments. The course also had an online lecture component. It was mandatory in this course to keep cameras on during online lectures to optimize student engagement, whereas other courses did not impose this requirement. According to recent research, many entering dental students had never taken online classes, and many were uncomfortable with commonly used online interactive learning strategies.[10] These findings indicate that additional interventions may be required to prepare dental students for success with online learning. Previous literature also indicates that many dental faculty members lack experience and expertise in using online educational platforms and technology.[2] To address these concerns, dental educators may need to develop new instructional methods to optimize online learning, such as "flipped" lectures and breakout rooms.[11]

4.1 | Study limitations

One limitation of this study is the 20.5% response rate. While the response rate is consistent with other survey-based studies for healthcare professionals, the generalizability of our results to a larger population may be limited for this reason.[12] Second, to ensure anonymity and confidentiality of responses, both the Pilot and follow-up surveys did not collect individual students' identifying information, limiting the ability to correlate an individual student's response to grades and the ability to conduct a trend analysis examining the change of attitude between the pilot and follow-up surveys.

Finally, like most other survey-based studies, cross-sectional studies are particularly subject to recall bias.[13,14] Studies have shown that the longer the length of a recall period, the greater the effects of recall bias.[15] To minimize recall bias, we sent out the follow-up survey, while hybrid curriculum was still in place at WesternU, adjusting survey questions relevant to our curriculum and reverse scoring the follow-up survey.

5 | CONCLUSIONS

Overall, it appears that the pandemic offered a more beneficial learning environment for students, as the post-Covid cohort (DMD Class of 2024) grades were overall higher in comparison to their pre-Covid cohorts. Even though one could argue that students performed better academically due to the pandemic, one must consider at what cost? Most students expressed concerns resulting from the pandemic, whether it be financial, regarding group studying, or mental health concerns. While online learning can be used effectively in dental education, educators need to consider the diversity of their students, in addition to situational factors that influence fair and equitable access to educational resources. Significant changes may need to be made in dental schools before "normality" can be achieved once again. This study demonstrates the need to understand dental students' attitudes and learning styles to create effective and high-quality dental education, in addition to understanding students' perceptions about the effectiveness of online lectures. Dental schools may be better equipped for the future by making accommodations toward mental health resources and investing in online platforms. This study also highlights the need for more readily available mental health resources within dental schools in the United States. At the university level, mental health was at the forefront of the university administration's next steps, and the findings of this study have since prompted decisions to provide more mental health services for students moving forward.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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