

BARRIERS EXPERIENCED BY UNDERGRADUATE STUDENTS TO ACCESS SUMMER RESEARCH POSITIONS IN MUSCULOSKELETAL SCIENCE AND PROPOSED SOLUTIONS

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Abstract

Summer research positions provide undergraduate students with formative research experiences, yet particular groups remain under-represented in securing these placements. This study sought to explore how faculty and students experienced the recruitment of summer research students in a musculoskeletal science context, and to identify potential solutions to support increased enrolment from under-represented student groups. A sequential research design was used. First, a survey was administered to inquire about current recruitment processes and suggestions for process changes, which then informed the content of semi-structured interviews with students and faculty. Participants were recruited via institute mailing lists, posters, and respondent-driven sampling. Thematic analysis was applied to interview transcripts. A review of student survey responses ($n = 26$) identified that the most common method to secure summer research positions was through unsolicited emails to faculty. The majority (62%) responded they were satisfied with the recruitment process, but almost half (46%) reported it was not fair to all students. Thirteen students and seven faculty participated in interviews. Six themes presented areas to address: hidden recruitment processes, timing of applications, emailing, connections, grade point average, and low compensation. Students proposed the implementation of a web-based platform and a networking event to improve the recruitment

process; however, faculty had reservations about these solutions. A multi-component strategy leveraging an equity framework and enhanced student engagement from under-represented student groups in all aspects of design is required. This strategy should include improved transparency of application processes, targeted recruitment, and adequate compensation to increase accessibility to summer research positions in musculoskeletal science among under-represented student groups.

Keywords: undergraduate research, accessibility, recruitment, student perspectives, equity

Résumé

Les stages de recherche d'été offrent aux étudiants de premier cycle des expériences formatrices en recherche. Toutefois, certains groupes demeurent sous-représentés dans l'accès à ces postes. Cette étude visait à explorer la manière dont les professeurs et les étudiants vivent le processus de recrutement des stagiaires d'été en sciences musculosquelettiques, ainsi qu'à identifier des pistes de solution pour favoriser une participation accrue des étudiants issus de groupes sous-représentés. Un plan de recherche séquentiel a été utilisé. Dans un premier temps, un sondage a été mené afin d'examiner les processus de recrutement actuels et de recueillir des suggestions de changements à y apporter. Les informations récoltées ont ensuite servi de base à l'élaboration du guide des entrevues semi-dirigées menées auprès d'étudiants et de professeurs. Les participants ont été recrutés à l'aide de la liste de diffusion électronique de l'Institut, d'affiches et par échantillonnage en chaîne. Une analyse thématique a été réalisée à partir des transcriptions d'entrevues. L'analyse des réponses au sondage étudiant ($n = 26$) a révélé que la méthode la plus courante pour obtenir un stage de recherche d'été consistait à envoyer des courriels non sollicités aux professeurs. Bien que la majorité des répondants (62 %) se soient dits satisfaits du processus de recrutement, près de la moitié (46 %) estimaient qu'il n'était pas équitable pour l'ensemble des étudiants. Treize étudiants et sept professeurs ont participé aux entrevues. Six thèmes principaux ont émergé : le caractère implicite du processus de recrutement, le moment opportun pour postuler, les courriels non sollicités, les réseaux de contacts, la moyenne cumulative et la faible rémunération. Les étudiants ont proposé la création d'une plateforme en ligne et d'événements de réseautage pour améliorer le recrutement; cependant, les professeurs ont exprimé certaines réserves face à ces solutions. Une stratégie multimodale, fondée sur un cadre d'équité et intégrant l'engagement actif des étudiants issus de groupes sous-représentés à toutes les étapes de la conception, est nécessaire. Cette stratégie devrait inclure une plus grande transparence des processus de candidature, un recrutement ciblé et une rémunération adéquate afin d'améliorer l'accessibilité aux stages de recherche d'été en sciences musculosquelettiques pour les groupes sous-représentés.

Mots-clés : recherche de premier cycle, accessibilité, recrutement, perspectives étudiantes, équité

INTRODUCTION

Every year, summer research positions at academic institutions provide undergraduate students with one-on-one mentorship with experienced researchers, including post-doctoral fellows and faculty. These work positions—called undergraduate summer studentships in Canada—provide experiential learning. These opportunities foster leadership skills such as critical thinking, professionalism, and teamwork (Lopatto, 2017), which supports the students' academic development (Carpi et al., 2017; Haave & Audet, 2013; Hunter et al., 2007). Undergraduate research experience can improve self-efficacy and encourage students to become scientists or pursue discipline-specific careers (Jones et al., 2010) and are foundational to building a pathway to a career in academia (Petrrella & Jung, 2008).

As many academic institutions grapple with addressing historical under-representation of Black and Indigenous academics due to the reverberations of colonialism and racism that persist, a close inspection of early entry points into academic pathways, such as summer studentships, is necessary to ensure they are actively anti-racist, and socially just. Studentships can increase the retention of students from under-represented groups in their undergraduate programs (Carpi et al., 2017), which supports societal goals of increasing diversity in various fields of research. For example, when racialized undergraduate students in biology at the University of California, Davis conducted research, it increased their probability of graduating (i.e., from 0.65 to 0.95 for “African Americans” and from 0.56 to 0.90 for “Native Americans”; Jones et al., 2010). Increasing diversity and representation based on gender, race, ethnicity, and other social characteristics in academia leads to better and more impactful science (Bear & Woolley, 2011; Díaz-García et al., 2013; Freeman & Huang, 2014; Kamerlin, 2020), and is necessary for health care innovation, optimal quality of care, and improved patient outcomes (Gomez & Bernet, 2019; Johnson et al., 2021). Thus, it is important to foster an education system that promotes diversity among staff and faculty with representation of the people it serves

to both increase equity and improve the impact of societal contributions made by academia.

The University of Calgary is a research-intensive university that has articulated an institutional equity, diversity, and inclusion (EDI) framework to guide its academic and research activities (University of Calgary, 2023d). Central to this framework is the commitment to removing barriers encountered by equity-deserving groups, including women, Indigenous Peoples, visible or racialized minorities, persons with disabilities, and LGBTQ2S+ individuals. The framework emphasizes the development and implementation of institutional policies and initiatives that foster equitable pathways, inclusive participation, and accountability for outcomes. It further prioritizes engagement with the campus community and the use of data and institutional reporting to inform, monitor, and advance equity and inclusion goals. Collectively, these principles are intended to address the ongoing impacts of colonialism, racism, and other historical and contemporary forms of exclusion within academic environments (University of Calgary, 2023d). We leveraged these principles as the framework to guide our inquiry. One of the University of Calgary's institutes, the McCaig Institute for Bone and Joint Health (University of Calgary, 2023c), comprises a multidisciplinary group of scientists—clinicians, engineers, basic scientists and research trainees, whose disciplines include cellular sciences, engineering, and medical and surgical science—working together to preserve and improve musculoskeletal health. Annually, the Institute's faculty offer undergraduate summer studentships, typically lasting 12 to 16 weeks. The goal of these studentships is to foster a future generation of academic musculoskeletal health researchers (University of Calgary, 2023e).

During a committee meeting at the Institute in early 2022, discussions about undergraduate summer studentship recruitment identified that there was no formal recruitment process in place. The committee identified that inefficiencies and inequities in recruitment may hinder the university's overall goal of fostering EDI. We, therefore, conducted this work to better understand the current recruitment processes and areas where studentship processes hinder

under-represented student groups. The project sought also to identify alternative recruitment processes to address any identified EDI and accessibility issues in the Institute's undergraduate summer studentships.

METHODS

Study Design

We used a sequential study design, which started with a student survey that subsequently informed the questions we used for interviews with faculty and students. Quantitative data from the survey and qualitative data from the interviews were analyzed to develop a comprehensive understanding of the recruitment process for undergraduate summer studentships at the Institute and ideas to improve it. Ethics approval was obtained from the University of Calgary Conjoint Health Research Ethics Board (REB22-0714) and all participants provided informed consent.

Study Team

Our study team was comprised of three students (Yousif Al-Khoury, Karys Maddison Hildebrand, and Kurt Nicholas Hildebrand), one research associate (Kiran Dhiman), two faculty members (Claire Barber and Cheryl Barnabe), and an external qualitative research consultant (Clayon Hamilton). The students were an undergraduate electrical engineering student (Yousif Al-Khoury) who was undertaking an undergraduate summer studentship at the Institute and two PhD students (Karys Maddison Hildebrand and Kurt Nicholas Hildebrand) in medical sciences who are members of the Institute's education committee. The students had no prior experience in conducting qualitative research but underwent training for this study and were supervised by Clayon Hamilton and Claire Barber and supported by Kiran Dhiman. Cheryl Barnabe is a professor, and Claire Barber is an associate professor at the Institute; both are clinician scientists and practising rheumatologists with experience in qualitative research. Cheryl Barnabe's research has a focus on health equity, and Claire Barber's on quality of care. Both have experience in supervising summer students and

have held leadership and committee positions at the Institute. Kiran Dhiman has a Master of Public Health degree and three years' experience in qualitative research. Clayon Hamilton specializes in health services research and has over 10 years' experience in leading studies using mixed-methods and qualitative research methods. The team was diverse in terms of gender (three men and four women), race (e.g., Black, White, Arabic, and Métis), and level of research experience (from undergraduate student to full professor). The team's diverse composition helped ensure that the study design, analysis, and recommendations were comprehensive, relevant, appropriate, and reflective of the varied realities faced by students and faculty of differing backgrounds. The first author, who is Arab and was an undergraduate student at the time of the study, has experienced barriers in finding undergraduate studentships. This background provided valuable insights into the challenges faced by other students, shaping the approach taken in this study and the recommendations proposed for more equitable recruitment practices.

Survey and Recruitment

Our team developed a 15-item questionnaire (Appendix A), hosted on the Qualtrics online survey platform. It contained five items covering demographic questions about age, gender, race, annual household income, and grade point average (GPA). The remaining 10 items asked about scholarships, employment during the fall/winter semester, relation to the Institute, experience applying for and obtaining a summer research position, support during the recruitment process, satisfaction level, and alternative strategies to support the recruitment process. Some of these questions used a 5-point Likert response scale to capture levels of satisfaction ("not satisfied at all" to "satisfied") and levels of agreement ("strongly disagree" to "strongly agree"). The survey questions were selected to reflect our university's EDI framework by capturing transparency and fairness in recruitment, barriers to equitable access, and facilitators of participation, and were informed by a preliminary review of the literature as well as our collective and diverse team experiences. The survey was distributed during

the summer of 2022 to current Institute graduate students ($n = 210$) and summer students ($n = 63$) via email. A respondent-driven sampling strategy was also used to obtain responses from past summer students and unsuccessful applicants to undergraduate studentships in the Institute. The results of the survey were subsequently used to develop the interview guide.

Interviews

Our team developed two semi-structured interview guides (see Appendix B); one for faculty members and one for students. The interview questions were organized into three main topics: motivation for seeking a summer student position, recruitment process, and suggestions for improvements. Participants were recruited through emails to current summer students and faculty at the Institute and through study posters around the Institute. During the consent process and prior to being interviewed, participants were informed that the purpose of this study was to better understand current experiences with undergraduate summer studentship access in order to inform strategies to increase access and improve processes. The primary interviewer (Yousif Al-Khoury) disclosed being a fellow undergraduate summer student.

Each student participant received a \$25 gift card plus a \$25 gift card for each person they referred who became a student participant. This respondent-driven sampling strategy was conducted to recruit students who were unlikely to be reached via the Institute's current mailing lists and, more specifically, individuals who were not successful in securing a summer research position. Interviews, scheduled for one hour, were conducted by one interviewer (Yousif Al-Khoury) accompanied by an observer (Karys Maddison Hildebrand or Kurt Nicholas Hildebrand), who took notes to inform data analysis. Participants could choose to be interviewed via Zoom or in person. Yousif Al-Khoury received interview training from an experienced qualitative interviewer (Clayon Hamilton), including a practice interview session. The interviews were recorded, transcribed verbatim, and anonymized. The transcripts were not returned to the participants for feedback or correction.

Analysis

Descriptive analysis was conducted on the survey data to understand student demographics and inform the interview guide. The interview transcripts were analyzed using thematic analysis guided by Fereday and Muir-Cochrane's (2006) six-stage approach involving inductive and deductive coding (Braun et al., 2019). In these stages we (1) developed the code manual, (2) tested the reliability of the codes, (3) summarized the data and identified initial themes, (4) applied the template of codes and conducted additional coding, (5) connected the codes and identified themes, and (6) corroborated and legitimized themes. Several iterations of analysis were done to strengthen the themes. NVivo software (version 12) was used to manage the qualitative data and facilitate analysis.

The code manual included three overarching code categories: barriers, facilitators, and suggestions for process improvements. These categories were predetermined for analysis to identify strengths and weaknesses in the current recruitment process and gather feedback on potential strategies to improve the recruitment methods. During coding, two additional overarching code categories were added: process (described summer student recruitment processes in a neutral way as neither a facilitator nor a barrier) and motivators (described students' motivations for applying for summer studentships). Themes were identified by examining the coded data qualitatively, focusing on recurring ideas and concepts that emerged most prominently across the coded data. Through this qualitative analysis, patterns in participant responses were noted, and themes were developed based on the most observed concepts. Each transcript was reviewed independently by two of the three student coders (Yousif Al-Khoury, Karys Maddison Hildebrand, and Kurt Nicholas Hildebrand). Weekly meetings were held to review coding and identify themes with a faculty member (Claire Barber). The process and methodology were overseen by a researcher (Clayon Hamilton).

RESULTS

Result from Student Survey

Twenty-six respondents completed some or all of the 15 items on the survey. Table 1 outlines the demographic characteristics of the survey respondents, and Table 2 outlines the responses to each item. Most respondents (62%) were “somewhat satisfied” or “satisfied” with their experience of the summer student recruitment process. Just under half of students (46%) who responded viewed the process as “unfair to all students,” and the majority of students (58%) reported that they had experienced barriers to obtaining an undergraduate summer studentship at the Institute.

Students most commonly (38%) applied for summer studentships by “cold emailing” faculty. Data not included in the tables show a small percentage of respondents (15%) had attempted, but failed to secure, a summer studentship, of which a majority (60%) applied through online job boards. Most respondents (88%) expressed agreement with the idea to implement a centralized web-based platform for summer studentship applications. Of the 26 respondents, 92% expressed agreement with holding an annual networking event between the Institute’s labs and undergraduate students.

Results from Interviews

Twenty participants, 13 students and seven faculty, were interviewed. Demographic characteristics of the students are shown in Table 1. All student participants had either completed or were currently doing a summer studentship at the Institute. We recruited no students who were unsuccessful in obtaining a summer studentship. Some students, however, had been unsuccessful with prior applications, and we asked them to share those experiences. Of the participating faculty, 57% identified as cisgender male, and 86% were of European descent. Fewer than half (43%) of the faculty were within five years of their academic appointment.

The thematic analysis identified six major themes: hidden recruitment process, timing of

application, emailing, connections, GPA, and low compensation, which are described below and summarized along with representative quotes in Table 3.

Hidden Recruitment Process

Several students expressed feeling that the recruitment process was not transparent.

My program didn’t...push it at all, either. They weren’t like, “Oh, go get studentships.” So, I was very...like, “Oh, is this something I should even do?”... It’s just like, so hidden, the whole process. (Student 12)

Information about available summer studentship opportunities and how to access and apply for them was not widely known by students. Student participants commonly said that they heard about studentship opportunities at the Institute through word-of-mouth and knowing the faculty as a family friend.

Timing of Application

Some students who were initially unsuccessful in securing a summer studentship described how they learned about the opportunities too late in the fall semester and thus missed the opportunity to apply for funding toward their summer studentship.

Well, I guess the reason I defined it as late, because a lot of labs responded to me saying “I already have summer students,” or, “I already have undergraduates that I work with.” I started applying around November. (Student 2)

Faculty stated that they would typically not recruit students after the deadlines for funding applications had passed. They also shared that they typically recruit students on a first come, first served basis. This means that students who emailed faculty after the fall semester had a lower chance of securing a studentship than students who emailed earlier in the year. “I took the first person who sort of like, came to me” (Faculty 1).

Table 1*Demographics of Student Participants from the Study Survey (n = 26) and Interviews (n = 13)*

Characteristic	Survey (n = 26)		Interviews (n = 13)	
	n	%	n	%
Relationship to the Institute				
Current summer student	16	62	11	84.5
Past summer student	6	23	2	15.5
Previously attempted to get a research position	4	15	0	0
Grade point average (GPA)				
2.7 - <3.0	2	7.5	--	--
3.0 - <3.3	2	7.5	--	--
3.3 - <3.7	4	15.5	--	--
3.7 - 4.0	15	58	--	--
Prefer not to answer	3	11.5	--	--
Gender				
Man	9	34.5	5	38.5
Woman	14	54	8	61.5
Non-Binary	1	4	0	0
Prefer not to answer	2	7.5	0	0
Racial group¹				
White	10	38.5	4	31
Southeast Asian	6	23	5	38.5
South Asian	5	19	4	31
Arab	4	15.5	0	0
Indigenous	1	4	0	0
Latin American	0	0	1	7.5
Annual household income in Canadian dollars²				
< \$40,000	6	23	5	38.5
\$40,000 to < \$80,000	3	11.5	1	7.5
\$80,000 to < \$160,000	6	23	3	23
\$160,000 to < \$200,000	0	0	0	0

Characteristic	Survey (n = 26)		Interviews (n = 13)	
	n	%	n	%
More than \$200,000	3	11.5	2	15.5
Prefer not to answer	8	31	2	15.5
Age in years				
Less than 21	9	35	8	61.5
21–25	13	50	5	37.5
26–30	2	7.5	0	0
Prefer not to answer	2	7.5		
Employment status during fall/winter term				
Employed	10	38.5	--	--
Unemployed	13	50	--	--
Prefer not to answer	3	11.5	--	--
Highest level of education by parents/guardians				
Less than high school	1	4	0	0
High school graduate	0	0	0	0
Associate's degree	3	11.5	1	7.5
Bachelor's degree	9	35	6	46
Master's degree	5	19	2	15.5
Doctorate degree	6	23	4	31
Prefer not to answer	2	7.5	0	0
Had scholarship when seeking summer studentship				
Yes	11	42.5	--	--
No	12	46	--	--
Prefer not to answer	3	11.5	--	--

¹ Some individuals marked that they had more than one ethnicity. All marked ethnicities were counted. This is why the racial group section has more respondents than other sections.

² CAD \$1 is equal to USD\$0.74 at the time of this writing.

Table 2*Student Participant Results from the McCaig Institute Summer Student Survey (n = 26)*

Item	<i>n</i>	%
Method of obtaining a position		
Cold email to faculty member	10	38
Advertisement email from faculty	2	8
Online application	6	23
Other ¹	8	31
Satisfaction with Institute's recruitment process		
Not satisfied at all	2	8
Somewhat not satisfied	1	4
Neutral	6	23
Somewhat satisfied	7	27
Satisfied	9	35
Prefer not to answer	1	4
Current recruitment process is fair to all students		
No	12	46
Yes	11	43
Prefer not to answer	3	12
Faced barriers during application		
No	8	31
Yes	15	58
Prefer not to answer	3	12
Level of agreement with a web-based platform for recruitment		
Strongly disagree	0	0
Disagree	1	4
Neutral	0	0
Agree	9	35
Strongly agree	14	54
Prefer not to answer	2	8
Level of agreement with annual networking events		
Strongly disagree	0	0
Disagree	0	0
Neutral	0	0
Agree	12	46
Strongly agree	12	46
Prefer not to answer	2	8

¹ "Other" responses related to personal connections, including contacts through friends, prior connection with supervisor, family connections, continuation with honours supervisor, or connection with supervisor or graduate students from lab during conference, or other events.

Table 3

Major Themes of the Recruitment Process and Barriers to and Facilitators of Recruitment Identified from Interviews with Students and Faculty

Major theme	Quotes from participants	
	Facilitator	Barrier
Hidden Recruitment Process The recruitment process for undergraduate summer research has often been described as being “hidden” and that many students aren’t aware of these opportunities.	“So it was just like through word of mouth, I guess, like, my friend telling me that.” – Student 12	“I think most people don’t apply because they have no idea that is even possible.” – Faculty 6
Timing of Application Describes when a student applies to an undergraduate summer research position.		“It’s probably more along the lines of, like, first come, first serve.” – Faculty 4 “I ended up asking a little too late for first year.” – Student 12
Cold Emailing Students often send a cold email (an email sent without prior interactions with the recipient) to faculty members inquiring about open undergraduate summer research positions.	“I feel like I personally benefited a lot from the system that, uh, like, from knowing my supervisor beforehand, which, like, most people don’t have that kind of opportunity, right?” – Student 9	“I don’t think it’s a great system.” – Faculty 7 “I think you miss out some people who are just introvert and they’re not as, as cocky.” – Faculty 1
Connections A student’s connections to members of a research institute may help or guide a student through an undergraduate summer student research recruitment process.	“You need to kind of know someone, um, in order to get in.” – Student 11 Interviewer: “A- and how did you know your supervisor?” Interviewee: “Um, I guess, like, family friend, kind of.” – Student 9	“I feel like, um, a lot of people get positions through, like, connections, which I feel like Black and Indigenous people are less, it’s like, you don’t have as many, you probably aren’t gonna have, like, a family friend that’s a professor.” – Student 1

Major theme	Quotes from participants	
	Facilitator	Barrier
Grade Point Average (GPA) GPA is considered a deciding factor in a student's ability to get a summer research position as it is one of the main criteria that undergraduate scholarship applications are assessed on.	"The thing is, my GPA is pretty high, um, which makes it a lot easier." – Student 1	"I think the main criteria's been whether or not I thought they could get a scholarship. Um, so that ends up coming back to academic transcript as being the primary reason for rejecting people." – Faculty 7
Low Compensation Compensation given to students for undergraduate summer research is relatively less than a student can earn from other jobs.		"It essentially creates this inequality where only people who are, who are...only people who are rich enough, or only people who have enough money to go an entire summer without being paid can have the opportunity to be summer students." – Student 2 "I have friends who, like, wouldn't be able to make \$7,500 in, yeah, over the course of the summer. Like, they have, uh, they're not in that financial position, you know what I mean?" – Student 9

Emailing

Most students apply for a summer studentship by emailing faculty. Students who had no prior relationship with potential supervisors were unsure of how to identify faculty or draft a “cold email” to them. Most students who sent a cold email indicated they found faculty through the university’s faculty web page and that it was unclear who was recruiting summer students. Some students felt this system was a poor way to find a studentship, while others found it enabled them to review a broad number of studentship possibilities.

It’s kind of like, okay, let me search up this...let me look at this massive list of professors. Let me read about like, 10, 15 of them. Here’s the ones I’m interested [in]. Now, let me read about all their research, and now let me, like, craft emails to each one specifically. So, uh, I think it’s a lot more open, if that makes any sense. (Student 2)

Connections

Existing connections between students and faculty were noted as a facilitator for securing studentships.

I’d also say like, I didn’t really know that studentships were available unless I had done the practicum and had done like, research through that, and then my PI [Principal Investigator] said, “Hey, you should apply to this.” (Student 5)

One student who had prior connections with a faculty member highlighted that their process was different from most students’.

For me, it was very...I would say my experience was a lot different than most people, because as far as I know, people would just start email—emailing professors, um, at a certain time point. But, for me, like I said, uh, the previous, um, academic year I worked on my honours thesis with my supervisor. And then, coming closer to the end of the semester, she asked me if I wanted to continue

the work, um, as a summer student for the summer. And I said, “Yes.” Um, so I thought that it would be a great opportunity, and that’s pretty much the pipeline of how I got into my summer studentship position. (Student 11)

Some students stated that, without their prior connections with a member of faculty, they likely would not have obtained a studentship. One student commented that individuals from groups under-represented among faculty, including Black and Indigenous academics, may be less likely to have such connections through family and friends. Thus, they are at a disadvantage compared to students with these kinds of connections.

I feel like, um, a lot of people get positions through, like, connections, which I feel like Black and Indigenous people are less—[likely to have]...I’m [race], so I know what it’s like too. So, it’s like, um, you don’t have as many, like, like, you—you probably aren’t gonna have, like, a family friend that’s a professor, if that makes sense? Yeah, unfortunately. (Student 1)

Grade Point Average (GPA)

Students and faculty were asked about how GPA plays a role in the summer student recruitment process. Students with a high GPA (above 3.5 on a 4.0 GPA scale) felt it played a role in their recruitment. As GPA is often used by funding agencies as a criterion for summer studentship funding, faculty use it as a primary measure for evaluating suitability for hire.

Some faculty did not consider that having a high GPA played a major role in the recruitment process. These faculty considered hiring students above a certain minimum GPA and were open to working with anyone above that threshold. Faculty mentioned that if more funding was available, they would be willing to supervise students with “lower” GPAs. However, scholarships are currently only awarded to students above a GPA cut-off, among other academic considerations.

If the student is working for me, and I don't have grant money, then essentially they need to get an award. (Faculty 2)

Low Compensation

Students noted that funding for summer studentships was inadequate and potentially limiting for students with greater financial stressors. The income from summer studentships is not taxable, as compensation is generally disseminated through scholarships. However, a student who is on a 16-week full-time summer studentship will earn less than someone working in a full-time non-academic job at minimum wage in Alberta.

I think if you break it down hourly, I don't believe that people doing, like, summer research positions get paid minimum wage, even. Um, I think there's even, like, an exemption by the government of Alberta that says that, like, you don't have to pay summer students minimum wage, right? And so I feel like, like, I know a lot of people who don't have the same fortunate financial background that I do, and they can't afford to have these kinds of positions. (Student 9)

Suggestions for Process Improvements

It emerged from the interviews that the current recruitment process for securing a summer studentship includes three main components: cold emailing a potential supervisor, receiving feedback, and applying for funding. There were several suggestions to improve the recruitment process as described below. These suggestions include implementing workshops, a job board, a website that displays supervisors' availability, a matching platform, a ranking system, and networking events. They are summarized with illustrative quotes in Table 4.

The students emphasized that increasing awareness of the Institute and providing guidance on the summer studentship process through workshops and outreach would benefit future applicants. Suggestions for outreach

included Institute-level efforts, as compared to efforts by individual faculty, to connect with under-represented groups to improve awareness of opportunities at the Institute.

Participants suggested that workshops could improve students' confidence about contacting faculty with whom they had no prior relationship. Students did not want to abandon the emailing aspect of recruitment and viewed it as a learning opportunity to improve their professional communication and networking skills.

Using websites and job boards was discussed as another potential solution. For example, some participants endorsed our idea of a maintained website that listed all faculty open to taking on summer students, along with their current contact information. Some students suggested having a job board where faculty could advertise studentship positions open for online applications. Faculty had some concerns about the potential workload involved in reviewing online applications. It was noted that a job board could result in some students applying for all open positions, which would increase the likelihood of a few top candidates being picked by several faculty.

Students expressed that having connections at the Institute was vital to getting a summer studentship. All the students who responded to the question about having annual networking events endorsed this idea. Networking events could also allow for more personal interactions—for example, students could engage with faculty to learn about their research and how to get involved. Some faculty noted the difficulty of organizing networking events that serve students from various academic backgrounds.

Table 4*Major Themes for Possible Strategies to Improve the Summer Student Recruitment Process*

Suggestions	Pros	Cons/Areas of concern	Quotes
Workshops	Helps students understand the process of attaining a summer studentship.	Concerns about reaching out to the students who need help. How do you advertise such a workshop, and should it be conducted in person or online?	“Make it into a [workshop] video that people can play on the website.” – Faculty 3 “I think a carefully constructed workshop, not just presenting things by faculty but even graduate students who have lived the experience would be good.” – Faculty 5 “I think that could be beneficial...especially with the support of students that have gone through the process...I think a student club does it, it might seem more accessible to students.” – Student 4
Job board	Streamlined process that is more accessible to everyone.	Projects are usually developed after students are recruited, so supervisors would usually not have projects ready to be posted onto a job board during the academic year. Concerns about supervisors having to select from many more students. The same few top students are likely to be picked by all supervisors.	“I think that could potentially at least streamline the process.” – Student 4 “I have no idea then what the actual summer position will be yet.” – Faculty 6 “You’re gonna have people applying to, like, 10 or 20 job postings and just, faculty are gonna pick the same two people.” – Faculty 7

Suggestions	Pros	Cons/Areas of concern	Quotes
Website to display supervisors' availability	Removes uncertainty students face in knowing which supervisors are available. Reduces email clutter for supervisors who are not recruiting students.	Concerns about being able to maintain such a website and keeping it up to date.	"It would be really great if they had like, a sentence or a little section where it says if they're still accepting students." – Student 2 "It would save time on both ends. And email space." – Student 5 "It's like lukewarm emailing instead of the cold emailing." – Student 5 "The real challenge in that approach is keeping the website updated." – Faculty 6
Matching platform	A more streamlined process that gives some students a higher chance of securing a summer studentship. Reduces email clutter and uncertainty that students have when sending an email.	Some students raised concerns regarding the lack of independence students who use this platform will have in choosing their own supervisors. It would cost more resources to build and maintain such a platform.	"I would probably prefer to find my own supervisors and do my own research." – Student 10 "That would be a fairer process than what happens now where some people have access to all students, and some have none. Um, and some students have access to no supervisors, because they're just not as connected as other students are." – Faculty 1
Ranking system	A more streamlined process that is similar to the matching platform but gives students more independence in choosing which supervisors they would like to work with the most.	There's still a chance that a student might be paired with someone who does not align with their research interests. There also would not be an even distribution of students for each supervisor who ranked that supervisor highly.	

Suggestions	Pros	Cons/Areas of concern	Quotes
Networking events	Help students build connections, which has been proven as a contributing factor toward attaining a summer studentship.	Outreach concerns identical to workshop concern. Concerns about the engagements of students during these events.	“I went to one for engineering, where I, like, learned about the email template thing. They also had, like, a mixer, and I think it was really helpful for [inaudible], like, talk one-on-one to a student, and then the student could follow up with an email if they were interested in working for them.” – Student 1 “I think it would help most the people that don’t know where to start.” – Student 1 “So many diverse academic backgrounds. Like, how would you do it? Like, how would you operationalize something like that?” – Faculty 4

DISCUSSION

Despite efforts at the university to increase EDI among students and faculty, our study highlights that there is much room for improvement in the recruitment process for undergraduate summer studentships for research positions. Our results revealed six themes of areas to address, which were interrelated and impact students' chances of success in the recruitment process: hidden recruitment process, timing of application, connections, emailing, GPA, and low compensation. To address these areas effectively, the foundational principle of equity must be at the centre of any proposed changes. Racial equity and social justice should guide the transformation of summer studentship practices, including recruitment, applications, acceptances, mentor training, and compensation structures (McNair et al., 2020). Moreover, the voices and experiences of minoritized students and faculty must actively engage in these changes, ensuring their perspectives shape the practices to be inclusive and support the needs of under-represented groups.

We were unable—due to a small size—to evaluate responses based on specific socio-demographic features; however, we found consistent perspectives in responses from both faculty of the Institute and students, suggesting that overall, undergraduate students are not familiar with the recruitment process for summer research positions, consistent with other studies conducted in other disciplines. For example, undergraduate students in psychology at Northern Arizona University stated that they were unaware of undergraduate research opportunities, and the lack of a formalized system led to a word-of-mouth system, which contributed to unequal access to the opportunities (Wayment & Dickson, 2008). Multiple changes to overcome barriers related to the lack of awareness were subsequently implemented, such as improving application procedures, advertising, communication with majors, and the establishment of a departmental newsletter (Wayment & Dickson, 2008). These findings suggest that similar application-level changes are warranted within our Institute to improve clarity and equitable access to summer studentships.

Challenges arising from undergraduate students' lack of connections are related to other themes, such as lack of awareness about research positions and when to apply. Expanding a student's network in the field of musculoskeletal sciences could make them more aware of available research positions and application deadlines. From a student's perspective, the Institute needs to increase its outreach activities through organized networking events. However, faculty have concerns about the logistics of organizing such events to reach out to students from a variety of undergraduate programs. The Institute's outreach could, therefore, be delegated to student-led organizations and clubs at the university. In our opinion, this strategy would likely remove the logistical issues associated with the Institute contacting students directly, but it would require coordination and relationship-building with student-led organizations and clubs so that their student members receive the relevant information. The Institute recently initiated a targeted outreach approach, and there is already increased awareness about research opportunities among students, specifically students from under-represented groups, including the local chapter of the Canadian Organization for Undergraduate Health Research (Volunteer Connector, n.d.). The Canadian Organization for Undergraduate Health Research is an initiative with student bodies across Canada that consist mainly of minoritized students, and it aims to support university students from under-represented groups with valuable experience in health and medical research. Connecting with such initiatives could provide a structured way to engage these students and address inequities in access.

The current recruitment process relies heavily on emailing between students and faculty, generally with students cold emailing faculty. This presents significant administrative barriers, particularly for students who may not have existing networks or prior experience, further exacerbating inequity in the process. This echoes the findings of a study involving 377 undergraduate health science students at McMaster University in Canada. Students characterized the undergraduate research recruitment

process, which essentially required students to cold email faculty via the staff directory, as a significant administrative barrier (Luo et al., 2022). In that same study, the students revealed that they were frustrated by this process and suggested that there could be a streamlined process to enable them to connect with a potential supervisor (Luo et al., 2022).

To increase equity in the process, student participants in the current study suggested changes in the recruitment process by using a web-based platform to view which faculty were currently recruiting summer students and included a mechanism for contacting them through the platform. However, implementing such a platform for students is unlikely to solve issues of inequity in the process, as a similar system, without an intermediary reviewer, exists at the Institute for graduate students. This system has led to large volumes of email to faculty from prospective graduate students not eligible to apply for graduate programs or for whom there is not an appropriate fit for the graduate training opportunities. To prevent the platform from becoming an additional barrier, increased administrative oversight would be needed to help properly streamline eligible summer research applicants and assist with student-faculty matching for opportunities, as well as support students and faculty through the process. If a web-based platform is to meet the needs of all interest holders, the university may need to provide financial support, and faculty may need to commit some time specifically to the platform. The impact of the platform would need to be consistently monitored and assessed.

Broadening criteria for studentships may be necessary when it comes to GPA. In our study, both students and faculty identified GPA as a key factor shaping acceptance decisions and that may exacerbate inequities in access to summer research positions.

Low compensation for students was a perceived barrier for those in lower socio-economic circumstances, which indicates a need for improved funding options for students, specifically for underprivileged students. Typically, compensation for undergraduate summer research is provided in the form of scholarships, rather than

hourly wages. If students were to work full-time (40 hours per week) for the same period as the studentship, the total scholarship amount often equates to less than minimum wage. Some faculty acknowledged that this creates a significant financial disincentive for students who need to earn a living wage, particularly those from underprivileged backgrounds who may need to prioritize paid work to support themselves or their families. As a result, these students may be more likely to pursue other job opportunities that offer hourly wages, effectively limiting their ability to participate in research experiences. This finding aligns with the findings of a study that described funding as a key barrier preventing undergraduate students from working on summer research and obtaining a research position (Lei & Chuang, 2009). According to a recent systematic review of barriers to accessing undergraduate research in science, technology, engineering, and math (STEM), low, or no, compensation for undergraduate research studentships appears to be an issue throughout academia (Pierszalowski et al., 2021). However, there is limited published information on the impact of funding challenges on students of colour (Pierszalowski et al., 2021).

There needs to be a broader discussion within Canadian institutions and funding agencies about compensation practices for undergraduate research positions. This discussion should explore alternative models, such as switching to an hourly wage system that aligns with minimum wage standards, or significantly increasing the total compensation provided through scholarships, and greater consideration of non-academic factors in funding decisions. Such changes could help ensure that students from underprivileged backgrounds are not financially disincentivized from participating in valuable research opportunities, thereby promoting a more equitable and inclusive academic environment.

It is important to mention certain themes related to barriers to summer studentships as perceived by faculty were not captured by our study but are mentioned in the extant literature. Faculty may lack incentives to mentor undergraduate summer students (Hvenegaard et al.,

2013) as this is less likely to contribute to tenure-track promotion compared to teaching a course (Shanahan et al., 2017). Faculty members may also feel less equipped to be a mentor to students, believing they do not have mentorship skills (Brew & Mantai, 2017). It is possible that all faculty who participated in our study, being self-selected, had experience mentoring summer students, and thus viewed the activity favourably. This highlights the importance of mentor training in centring equity in summer studentship practices. Providing faculty with training in inclusive recruitment and equitable applicant evaluation, alongside institutional recognition of undergraduate mentorship within tenure processes, may support more consistent and equitable mentoring and acceptance practices.

Limitations

The scope of this study was a single large multidisciplinary academic institute, which may impact how findings are applied to similar institutes. Given the multidisciplinary nature of the Institute, we could have missed unique challenges to securing summer studentships because of the combined small sample size and diversity of academic disciplines. Our sampling strategy did not identify individuals who remained unsuccessful in obtaining a summer studentship, despite our attempts to recruit through referrals. Furthermore, most students included had parents who graduated from university, and Black and Indigenous students and faculty are under-represented in our sample. As such, the experiences shared may not fully reflect perspectives on challenges faced by students from groups historically excluded or underserved in higher education. Tailored recruitment strategies are needed to improve representation from these racialized groups. Despite this, our findings among relatively privileged participants show that the process of applying to studentships was often described as confusing, opaque, and intimidating. This suggests that moderate adjustments to existing practices, which may still be rooted in inequity, may not suffice to create equitable access.

The university has developed application processes for Indigenous students to ensure equitable admissions (University of Calgary, 2023b), but this has not increased enrolment of this equity-denied group into summer studentships at the Institute. Other programs within the university have developed application processes to address under-representation of Black students, including the Black Applicant Process for medical school admissions (University of Calgary, 2023a).

In conclusion, our work has identified several actionable strategies to address opaque processes and potential inequities in the administration of our Institute's summer undergraduate studentship program. Viewed through the institutional EDI framework, these inequities reflect barriers to equitable access and participation arising from limited transparency, reliance on informal networks, and structural constraints related to funding and compensation, which were identified through direct engagement with students and faculty as members of the campus community. We aim to work with students and faculty to co-design a more inclusive process leveraging our recommendations to actively recruit and support students from under-represented groups, with the overarching goal of fostering diversity and inclusiveness in the next generation of musculoskeletal researchers. We aim to continuously evaluate our processes and progress in optimizing summer studentship access and recognize that future engagement with those not currently represented in this work and in our undergraduate summer studentship programs will be necessary to further design and drive strategies to address under-representation, racism, injustices, and harms of colonialism in academia.

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APPENDIX A

Survey Questions

A Barrier Free Summer Studentship Study Survey

[Attached Survey Informed Consent Document]

1. What is your relation to the McCaig Institute?
 - a. I am a current McCaig Institute summer student
 - b. I am a past McCaig Institute summer student
 - c. I have previously attempted to get a McCaig summer studentship
2. How did you try to obtain a McCaig Institute Summer Studentship?
 - a. Cold email to a faculty member
 - b. Online application
 - c. Contacted professor after seeing an ad for wanted summer students in your email inbox.
 - d. Referral from a student club.
 - e. Other, please describe:
3. On a scale of 1 to 10 (1 being not at all satisfied, 5 being highly satisfied), what is your satisfaction level with the McCaig Institute summer student recruitment process?
4. [optional] Do you think the process of obtaining a summer studentship is fair to all students?
 - a. Yes
 - b. NoFeel free to elaborate if needed:
5. [optional] Have you faced any challenges in obtaining a summer studentship?
 - a. Yes
 - b. NoFeel free to elaborate if needed:
6. [optional] What was your GPA at the time you attempted to get a summer studentship at McCaig Institute?
 - a. 3.7 to 4.0
 - b. 3.3 to less than 3.7
 - c. 3.0 to less than 3.3
 - d. 2.7 to less than 3.0
 - e. Less than 2.7
7. [optional] Do you have any scholarships?
 - a. Yes
 - b. No

8. [optional] Do you have to work during your fall/winter semester to afford school or living expenses?
 - a. Yes
 - b. No
9. How much do you agree or disagree with a proposed plan of developing a web-based platform for faculty to post available summer research positions for students to apply to online?
10. How much do you agree or disagree with a proposed plan to hold annual networking events with McCaig Institute's faculty and University of Calgary's students, where faculty can talk about their current ongoing projects so students get an idea about what field of research they are interested in and who they should contact to get a studentship with that project?

The next part is a demographic survey. We require this to ensure we obtain a diversity of opinions.

1. Age (options b-f have ranges that are inclusive):
 - a. Less than 21
 - b. 21 – 25
 - c. 26 – 30
 - d. 31-35
 - e. 36-45
 - f. 46-55
 - g. Greater than 51
2. How do you currently describe your gender identity? Gender identity is a deeply held inner feeling of whether you are male or female, both or neither. Gender identity may be the same as the sex you were assigned at birth or not.
From MyHealth Alberta > Gender, gender identity, and gender expression: <https://my-health.alberta.ca/Alberta/Pages/gender-ID-expression-LGBTQ.aspx>
 - a. Male
 - b. Female
 - c. Indigenous or other cultural gender minority (eg. Two-spirit)
 - d. Something else (eg. Gender fluid, non-binary)
 - e. Prefer not to answer
 - f. You do not have an option that applies to me, I identify as: _____
3. Which categories describe you? Select all that apply.
 - a. Indigenous (First nations/Inuit/Metis)
 - b. White/European
 - c. Black/African/Caribbean
 - d. Southeast Asian (e.g. Chinese, Japanese, Korean, Vietnamese, Cambodian, Lao-tian, Thai, Filipino, etc.)
 - e. Arab (Saudi Arabian, Palestinian, Iraqi, etc.)
 - f. South Asian (e.g. Indian, Pakistani, Sri Lankan, etc.)
 - g. Latin American (e.g. Costa Rican, Guatemalan, Brazilian, Colombian, etc.)
 - h. West Asian (e.g., Iranian, Afghan, etc.)
 - i. Prefer not to answer

4. You do not have an option that applies to me, I identify as: _____
Household Annual Income (CAD):
- a. \$0 - \$9,999
 - b. \$10,000 - \$39,999
 - c. \$40,000 - \$79,999
 - d. \$80,000 - \$159,999
 - e. \$160,000 - \$199,999
 - f. \$200,000 - \$499,999
 - g. More than \$500,000
 - h. Prefer not to answer
5. Maximum level of education by parents/guardians:
- a. Less than High School
 - b. High School Graduate
 - c. Associate Degree
 - d. Bachelor's Degree
 - e. Master's Degree
 - f. Doctorate Degree
 - g. Prefer not to answer

[After pressing submit raffle link will be given to enter name and email address, those details will not be linked to the answers of this survey]

- 1. Name
- 2. Email Address:

APPENDIX B

Interview Guides

[Welcome and Introduction]

Thank you for taking the time to be here. My name is XX and I'm [study role] with this project. I will be going through the interview with you today. We also have XX present to take notes.

The purpose of this interview is to understand your experiences with the recruitment process of undergraduate summer students at McCaig Institute. Understanding your views on the process can help our work to optimize the recruitment practices for summer studentships in musculoskeletal research at the McCaig Institute.

There are no right or wrong answers. We are interested in any insights we can gain from your own experience.

This interview will take up to an hour. If you need to stop at any point, let me know and we can pause for as long as you need. We will be taking notes and the interview will be audio recorded so we do not miss any important details.

Before we get started, do you have any questions?

Do I have your consent to begin the recording? (Yes/No)

[Start recorder]

The questions below are for student participants:

- What was your motivation for seeking a summer studentship at McCaig Institute to conduct musculoskeletal research?
- How did you learn about the summer studentship opportunity to do musculoskeletal research at McCaig Institute?
 - If they reached out to a faculty member:
 - How many faculty members did you reach out to in your search for a summer studentship at McCaig Institute ?
 - Were you aware of the research project prior to sending an email?
 - If they found out about the position online:
 - Where did you find the posting for the position?
 - How many summer studentship positions did you apply for online?
- What was the result of your efforts to get a summer studentship to conduct musculoskeletal research at McCaig Institute?
 - If they were hired or received an offer:
 - What do you think contributed to you getting the summer student position to do musculoskeletal research?
 - [probe] Can you elaborate on factor X?
 - If they were not hired:
 - What do you think contributed to you not getting the summer student position to do musculoskeletal research?
 - [probe] Can you elaborate on factor X?

- Think back to the process you took seeking a summer studentship position to do musculo-skeletal research at McCaig Institute, what are your general thoughts on the process? And would you have preferred if the process was different?
 - If satisfied:
 - What strengths in the recruitment process make you feel positive about the process?
 - [probe] Tell me more about strength X.
 - If not satisfied:
 - Why were you not satisfied with the process?
 - [probe] Can you elaborate further on your dissatisfaction with the process? Are there any specific improvements to the recruitment process that could make it a more fair and equitable process for students seeking a summer position in musculoskeletal research at McCaig Institute?
 - [probe] How do you think this change will improve the process?
 - How about any specific improvements to make the process more fair and equitable to students from underrepresented racial and ethnic groups, such as black students and students belonging to an Indigenous people?
 - [probe] Can you elaborate further on how these changes will improve the process for underrepresented groups?

For the remaining questions, we would like your opinions on alternative recruitment approaches and any suggestions of your own.

- What is your opinion on a web-based platform, like a job board, to connect students to faculty looking for summer students for musculoskeletal research at the McCaig Institute?
 - Do you think using such a web-based platform would improve the recruitment process? (Yes/No) [optional: only if clear answer was not given]
 - [probe] Why do you think it would/would not improve the recruitment process?
- What is your opinion on an annual networking event with McCaig Institute's faculty and undergraduate students, where faculty would talk about their current projects to give undergraduate students an idea about the type of research they could do with specific faculty members?
 - [probe] Can you describe the reasoning behind your opinion?

The questions below are for faculty participants

- How do you usually recruit summer students onto an musculoskeletal research project?
- In what ways do you think your approach provides a fair access to undergraduates seeking a summer studentship?
 - Are there any particular key strengths in your recruitment approach?
 - [probe] Tell me more about strength X.
 - What could be improved in your recruitment process to provide a more equitable access to undergraduate students seeking a summer research position?
 - [probe] Can you describe improvement X further?
 - How about any specific improvements to make the process more fair and equitable to students from underrepresented racial and ethnic groups, such as Black students and students belonging to an Indigenous people?
 - [probe] Can you elaborate further on how these changes will improve the process for underrepresented groups?

We would also like to ask for your opinion on possible impacts of proposed alternative recruitment practices and any suggestions of your own.

- What is your opinion on a web-based platform, like a job board, to connect students to professors looking for summer students for musculoskeletal research at the McCaig Institute?
 - Do you think using such a web-based platform would improve the recruitment process? (Yes/No) [optional: only if clear answer was not given]
 - [probe] Why do you think it would/would not improve the recruitment process?
- What is your opinion on an annual networking event with McCaig Institute's faculty and undergraduate students, where faculty would talk about their current projects to give undergraduate students an idea about the type of research they could do with specific faculty members?
 - [probe] Can you describe the reasoning behind your opinion?

[Wrap up]

As the interview is coming to an end, do you have any final comments?

[Conclusion]

Thank you so much for making the time to be interviewed and for all your thoughtful contributions to the study.

If you have any questions or concerns, please be in touch with [name removed], Research Coordinator at [email address removed]