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Challenges to success among research trainees in Canada: insights from a national spinal cord injury conference

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Background: The active involvement of trainees in research is critical for scientific innovation. However, significant barriers hinder trainees' academic and professional success, limiting career advancement and impairing research translation. Few studies have applied a holistic model to analyze these challenges in Canada. This study aimed to identify multilevel challenges faced by Canadian research trainees to inform future interventions.

Methods: A multi-staged participatory workshop, including a literature review and group discussions with trainees, was held at a Canadian spinal cord injury conference. The Socio-Ecological Model (SEM) was used, and data were analyzed using deductive followed by inductive content analysis.

Results: Twenty-seven trainees participated, including undergraduate students ($n = 5$), MSc students ($n = 5$), PhD students ($n = 10$), post-doctoral fellows ($n = 6$) and a research associate ($n = 1$). Analysis of review findings at the pre-workshop stage identified four core themes: Financial, Logistical, Cultural, and Mental Health Challenges. Key findings post-workshop included severe financial pressures due to inadequate stipends and high living costs, unclear career pathways, cultural demands for productivity at the expense of wellbeing, and pervasive mental health struggles linked to stress and isolation. Financial and Logistical Challenges primarily affected trainees at the individual level, while Cultural and Mental Health Challenges were largely prevalent at the interpersonal level of the SEM.

Conclusion: Canadian research trainees face complex, interrelated challenges requiring systemic solutions. Increased financial support, improved mentorship, and institutional reforms could enhance wellbeing, career prospects, and retention of top talent, while supporting the development of research trainees.

KEYWORDS

academic career development, academic mental health, graduate education, socio-ecological model, trainee challenges

Introduction

Over the past century, global investment in higher education, particularly in Science, Technology, Engineering, and Mathematics (STEM), has grown substantially (Park et al., 2020; Altbach et al., 2010). This emphasis reflects a growing recognition of STEM training as a key driver of national development and socioeconomic progress (Anderson and Li, 2020). However, the demands placed on trainees (i.e., individuals in undergraduate to post-doctoral level programs) are considerable. Trainees are expected to master a wide range of complex, integrative skills, including advanced cognitive processes such as metacognition, making STEM education particularly rigorous (Pleasant et al., 2019; Ku and Ho, 2010).

Beyond the intellectual demands of STEM, structural and systemic challenges persist. These include inconsistencies in graduate curricula across countries (Taff and Clifton, 2022), unequal access to training between urban and rural areas (Saw and Agger, 2021), and limited opportunities in low-income regions (Altbach et al., 2010). Many trainees are compelled to study abroad without their support networks, which intensifies financial and mental health pressures (Geddie, 2013). Importantly, governmental investment in STEM education and research training has not grown sufficiently to maintain spending power, particularly when accounting for inflation and rising living costs in university towns. This stagnation has eroded the monetary value of scholarships and stipends, leaving many graduate students financially vulnerable and threatening Canada's ability to attract and retain top talent (Council of Canadian Academies, 2025; Laframboise et al., 2023). These issues were further magnified by the COVID-19 pandemic, which exposed deep-rooted vulnerabilities in academic systems and brought renewed attention to the mental health and financial struggles of research trainees (Roach et al., 2017; Jayman et al., 2022). Despite growing awareness, these challenges are often assessed using quantitative tools (e.g., questionnaires) that fail to capture the full scope of trainee experiences.

Recent research has proposed the Socio-Ecological Model (SEM) as a more holistic framework for understanding the barriers trainees face (Salihu, 2014; Ajayi et al., 2022; McLeroy et al., 1988). The SEM considers multiple levels of influence (individual, interpersonal, institutional, community, and policy), offering a comprehensive lens to examine trainee wellbeing and success. However, its application in Canadian research training environments remains limited.

To explore these issues, we conducted an interactive strategic planning workshop with Canadian research trainees. The workshop aimed to: (1) identify key challenges, (2) prioritize them through group consensus, and (3) reflect on strategies to address these priorities. This paper presents a synthesis of relevant literature and a summary of workshop findings, offering insights to inform future strategic initiatives in research training.

Methods

This paper describes the multi-staged approach used in the planning, execution, and post-workshop activities of the “High Caliber Trainees: How to be one, how to retain one” workshop. This workshop was delivered at the 10th National Spinal Cord Injury Conference, hosted by the Canadian Spinal Cord Injury Rehabilitation Association (CSCI-RA) in November 2023 in Toronto, Canada. The

target audience for this conference included individuals engaged in pre-clinical and/or clinical spinal cord injury (SCI) research. The workshop aimed to identify the key challenges to professional development faced by research trainees working with the SCI population in Canada. Support for this workshop was provided by the CSCI-RA. All trainees who participated in the workshop provided verbal consent to share their written ideas and were informed of the intention to disseminate the findings through publication. All trainees were invited to contribute as co-authors and agreed to co-authorship in writing. All trainees reviewed the manuscript and provided feedback on its content. This project did not require ethical approval according to the Tri-Council Policy Statement (TCPS-2, 2022, Article 2.5).

Stage 1: pre-workshop activities – review of the literature

A literature review of Nature's specialized sections (e.g., Career News, Career Feature) (Career View, 2023; Career Feature, 2023) focused on publications reporting challenges to successful trainee development in academia. The search returned 19 relevant articles (Supplementary Table 1), each reviewed and summarized by two authors (NC, LC, TW, AK, WS). A table summarizing concepts, including challenges and related issues, was then created. Next, authors (AK, WS) separately grouped challenges into categories, then met to discuss themes. Four themes describing the challenges experienced by trainees were identified: (1) Financial, (2) Logistical, (3) Cultural, and (4) Mental Health. The review provided a conceptual framework for Stage 2, whereby the themes were used to inform and guide group discussions during the workshop.

Stage 2: workshop – group discussions

The workshop was advertised through the CSCI-RA conference website, e-mail notifications to CSCI-RA members and delegates, and announcements throughout the event. Participation was voluntary and open to research trainees and early to late-career scientists. Attendees were randomly assigned to one of four tables. The workshop began with a presentation on the literature review findings and session objectives, followed by focused table discussions. Moderators (NC, EN, LC, TW), each representing one of the four themes, facilitated 10-min discussions during which they summarized their theme and invited attendees to share related experiences by answering two questions: (1) have you experienced any challenges in this area? and (2) is anything missing? At the 9-min mark, trainees anonymously recorded their top three challenges on a cue card before moderators rotated to the next table. All tables had the opportunity to discuss each theme, and moderators took field notes (Phillippi and Lauderdale, 2018) throughout the discussions, as well as reflexive notes after the workshop (Finlay, 2002). At the end, cue cards were collected and moderators shared high-level summaries of the group discussions. The session concluded with leads (AK, WS) outlining next steps and encouraging trainee involvement in future working groups. Trainees provided verbal consent for their written responses on cue cards to be collected and analyzed after the workshop. Trainees were also invited to participate as a co-author on a manuscript detailing workshop learnings as members of the 10th National SCI Conference Trainee Advisory Group (Supplementary Table 2).

Stage 3: post-workshop activities – data analysis

Trainee demographic information was summarized using frequency counts. Cue card data from group discussions were analyzed using a five-phase process that incorporated deductive and inductive content analysis (Bingham et al., 2023). In phase 1, LC and AK transcribed the raw data from the cue cards verbatim to Microsoft Excel (2021) and then organized them by the identified themes. The spreadsheet was shared with the 10th National SCI Conference Trainee Advisory Group for member checking (Birt et al., 2016). Two trainees made minor revisions. In phase 2, NC, EN, and TW conducted an inductive content analysis, reviewing raw data to identify codes within each theme and develop an initial codebook. In phase 3, the authors met to iteratively refine the codebook and improve code clarity. In phase 4, the SEM provided a theoretical framework for data analysis, where codes within each theme were further categorized across the SEM's five levels (Salihu, 2014). In phase 5, the relationship between themes, SEM levels, and codes was discussed, with findings described textually and visually through a table (Supplementary Table 3) and figure (Figure 1).

To identify the key codes, GL and WS counted the frequency of data points (i.e., individual quotes) in the raw data (Morgan, 1993). A heat map (Figure 2A) was created to visualize the data for the four themes, with darker cells representing codes that appeared more frequently (Słomska-Przech et al., 2021) and each cell displaying a frequency count. Figure 2B shows the distribution of total frequency across themes and SEM levels.

students ($n = 5$), MSc students ($n = 5$), PhD students ($n = 10$), post-doctoral fellows ($n = 6$), and a research associate ($n = 1$). No attendees identified as scientists. Twelve trainees were male, and 15 were female.

Analysis of cue card data identified that the themes of Financial, Cultural, Logistical, and Mental Health Challenges experienced by research trainees intersect the various layers of the SEM. A diagrammatic representation of the four themes of challenges and five levels of the SEM is visualized in Figure 1. Themes, SEM levels, codes, and code descriptions are detailed in Supplementary Table 3. The codes have been categorized based on challenges self-identified by trainees; thus, some overlap in codes may exist across the four themes (i.e., imposter syndrome appears both in Mental Health and Logistical Challenges). A brief overview of the relationship between themes, SEM levels, and codes is presented below.

Theme 1: financial challenges

Financial Challenges were associated with access to money, other financial resources, or compensation to support basic lifestyle affordability. At the individual level, trainees described lack of income and inadequate stipends to match the high cost of living as key challenges. A lack of funding opportunities and institutional policies restricting income were reported as significant challenges at the institutional level. From a community standpoint, workshop attendees reported experiencing negative social perceptions, such as the notion that salary is tied to professionalism and value. Trainees described one policy level challenge: how governing policies restrict income, such as restrictions in funding and limits in teaching assistantship hours.

Theme 2: logistical challenges

Logistical Challenges were defined as issues related to academia as a field itself and the dynamics of career development. From an

Results

Twenty-seven trainees from Canadian institutions attended the workshop, all involved in SCI research. Trainees included undergraduate

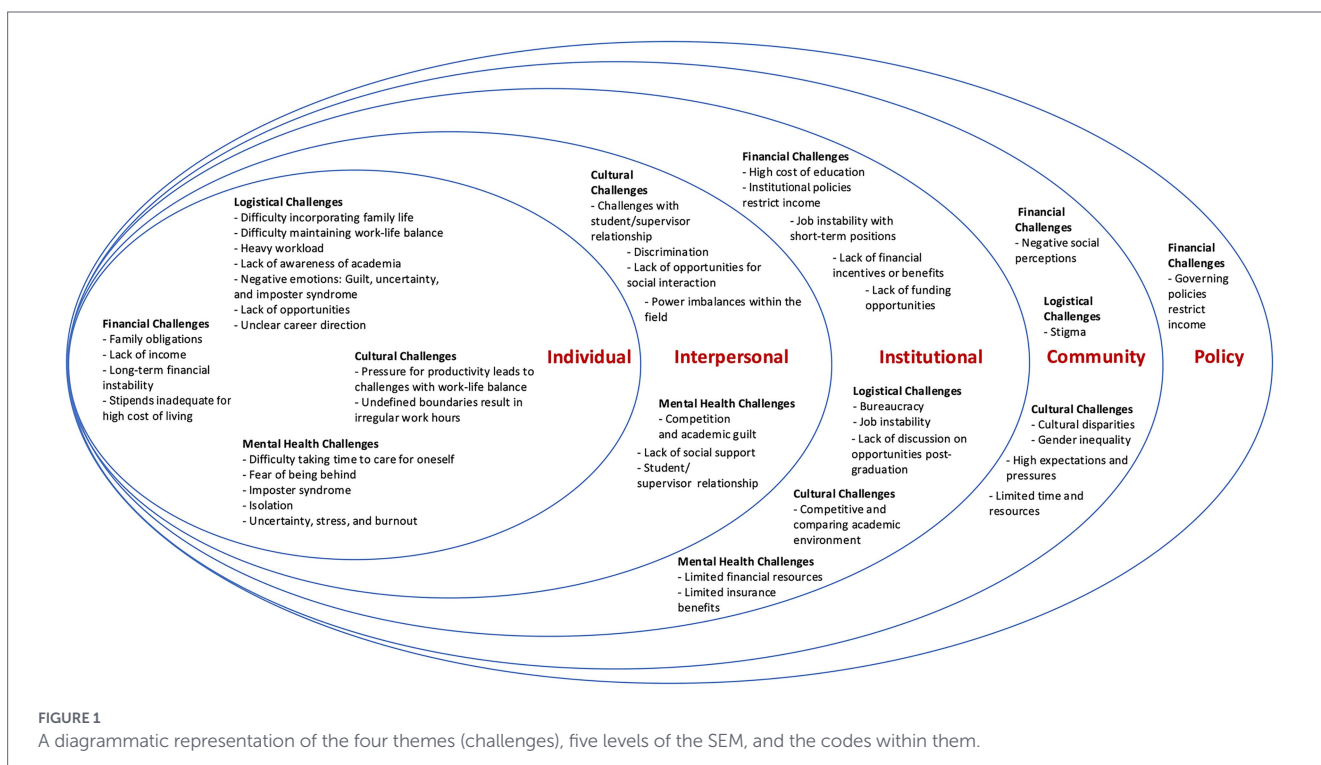
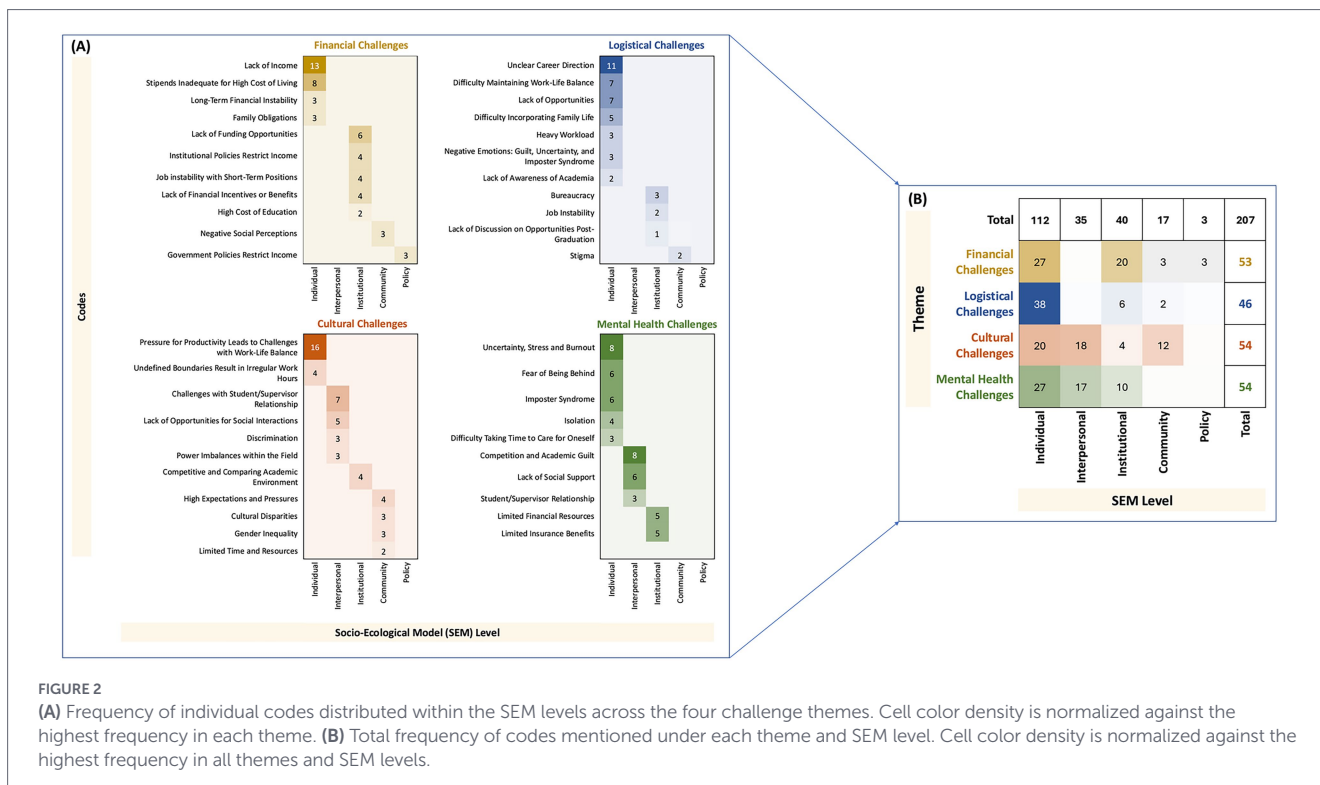


FIGURE 1 A diagrammatic representation of the four themes (challenges), five levels of the SEM, and the codes within them.



individual standpoint, trainees reported numerous difficulties, such as maintaining a healthy work-life balance and having an unclear career direction. Bureaucracy and job instability were two main challenges experienced at the institutional level, while societal and professional stigma was perceived at the community level.

Theme 3: cultural challenges

Cultural Challenges were defined as issues related to long-established or unspoken mindsets and behaviours common to the field. Individually, trainees described experiencing pressure for productivity, which led to challenges maintaining work-life balance, and how undefined boundaries resulted in irregular work hours. Primary interpersonal difficulties involved challenges with the student/supervisor relationship and a perceived lack of opportunities for social interaction. At the institutional level, the culture within the field was described as highly competitive and comparison-driven, where progress is often evaluated relative to others within the institution. Within the community, trainees primarily perceived challenges related to cultural disparities (e.g., due to relocating as an international student), gender inequality, and high expectations and pressures (e.g., high demand for output, productivity).

Theme 4: mental health challenges

Mental Health Challenges were described as issues that negatively impact the wellbeing and health of trainees and their psychosocial relationships. At the individual level, key challenges contributing to poor mental health were the fear of being behind, imposter syndrome, and burnout. Interpersonally, trainees reported competition, academic guilt, and lack of social support (e.g., family, peers) impacted their mental health. Finally, closely linked to Mental Health were financial difficulties experienced at the institutional level; trainees

described receiving limited financial resources and insurance benefits to support their healthcare needs as factors that affected their mental health.

The heat map (Figure 2) illustrates the distribution of key codes within each identified theme, with darker shaded cells indicating codes reported more frequently by trainees. Figure 2A represents the frequency of cited codes. The most frequently mentioned code was “Pressure for Productivity Leads to Challenges with Work-Life Balance” ($n = 16$) under the Cultural Challenges theme. The most cited code for Financial Challenges was “Lack of Income” ($n = 13$). In the Logistical Challenges theme, “Unclear Career Direction” ($n = 11$) was the most frequently mentioned, while in the Mental Health Challenges theme, the top codes were “Uncertainty, Stress, and Burnout” and “Competition and Academic Guilt” ($n = 8$ each). Figure 2B further underscores the distribution of challenges across SEM levels, revealing that most challenges were concentrated at the individual level ($n = 112$), followed by the institutional level ($n = 40$) across all themes. Financial and Cultural Challenges were the most widely dispersed across the SEM levels. Policy-level challenges were mentioned only within the context of Financial Challenges.

Discussion

This study highlights the complex, multifactorial barriers faced by Canadian research trainees in SCI fields. Financial, Logistical, Cultural, and Mental Health Challenges were identified as dominant themes, each intersecting across multiple levels of the SEM. These findings underscore the need for comprehensive, multi-level interventions that support the holistic wellbeing of trainees.

Financial challenges

Financial concerns were the most frequently cited challenge among research trainees, particularly inadequate stipends and long-term economic instability. These issues intersect at multiple levels of the SEM, with a disproportionate impact at the individual and institutional levels. Many trainees struggle to maintain a sustainable lifestyle due to high living costs, restrictive institutional policies, and limited opportunities for supplementary income.

A 2022 international *Nature* survey found that 85% of graduate students were concerned about affording basic necessities, with nearly half considering leaving their programs due to the cost-of-living crisis (Woolston, 2022). Similarly, a Canadian study reported that 85.7% of graduate students experienced financial anxiety, and 43.4% struggled to make ends meet (Laframboise et al., 2023). Institutional policies often discourage or prohibit external employment, while others compel students to work additional jobs to cover tuition, despite demanding academic responsibilities. Teaching and research assistantships, frequently mandatory, are often uncompensated beyond the base stipend (University of Waterloo, 2025). Even with scholarships, many trainees remain bound to fixed stipends, limiting their earning potential (Laframboise et al., 2023; Woolston, 2022). These challenges persist into postdoctoral training, where only 40% report satisfaction with their salaries, often feeling undervalued and demoralized (Sabbagh, 2023).

Doctoral students contribute to one-third of all scientific publications (Larivière, 2012), underscoring their critical role in research. Yet, expecting them to live at or below the poverty line is unsustainable (Fraass et al., 2024; Langford and Carstairs, 2023; Tabbara and Talwar Kapoor, 2023). A fundamental shift in funding models is required, including increased stipends, flexible funding mechanisms, and expanded paid teaching opportunities. The 2024 Canadian Tri-Agency scholarship increase is a step forward, but it remains below the living wage in major cities (Pickthorne, 2024). Meaningful, structural changes are essential to ensure the financial wellbeing of trainees and the long-term sustainability of academic careers.

Logistical challenges

Logistical challenges significantly impact the wellbeing of research trainees, particularly those in early-career stages. These multifaceted barriers span individual, institutional, and community levels, often creating tension between academic demands and personal life. Trainees frequently reported difficulties balancing family responsibilities, managing heavy workloads, and navigating institutional bureaucracy. Without clear career pathways, many trainees feel underprepared for both academic and non-academic roles.

These findings align with existing literature highlighting elevated stress and burnout among Canadian academics, particularly early-career researchers navigating the dual pressures of personal obligations and career advancement (Salimzadeh et al., 2020). Emotional burdens such as imposter syndrome, guilt, and uncertainty often stem from the precarious and poorly structured nature of academic pathways (Hutchins, 2015). Structural barriers, including bureaucratic hurdles, job instability, and unclear post-graduate trajectories, further compound these challenges, contributing to high turnover and discouraging long-term commitment in academia (Fitzpatrick, 2017; Spina et al., 2022). Without clear career pathways, many trainees feel underprepared for both academic and non-academic roles.

The absence of structured career guidance and institutional support for work-life balance fosters uncertainty and stress, complicating career development (Salimzadeh et al., 2020; Spina et al., 2022; Maldonado et al., 2013).

Addressing logistical challenges requires both structural and cultural shifts within academia. Institutions should prioritize policies that support work-life balance, reduce scheduling conflicts, and provide comprehensive career guidance. Enhancing job security, streamlining administrative processes, and promoting diverse career paths without stigma are essential to fostering a more inclusive and sustainable academic environment.

Cultural challenges

Cultural challenges were identified as a significant barrier to research trainee wellbeing, shaped by complex interactions across individual, interpersonal, institutional, and community levels of the SEM. A dominant theme was the pressure to constantly produce and succeed, often celebrated as dedication, which undermines work-life balance and contributes to burnout. This aligns with literature describing academia's culture of overwork, where long hours and continuous output are seen as prerequisites for advancement (Hawkins et al., 2014).

Trainees frequently reported feelings of guilt and inadequacy when unable to meet these expectations or when prioritizing non-academic responsibilities. This culture fosters chronic stress and disengagement, perpetuating a cycle of poor mental health. Interpersonal dynamics, particularly strained student-supervisor relationships and experiences of subtle discrimination, further compound these challenges. Such dynamics reinforce systemic inequities and power imbalances, especially for marginalized groups (Friedensen et al., 2024; Benuto et al., 2020).

Cultural norms identified in this study not only hinder personal and professional development but also contribute to a toxic academic environment. The competitive nature of academia, deeply embedded across SEM levels, makes it resistant to change through isolated interventions. Research consistently links such environments to declines in mental health and overall wellbeing among trainees (Hawkins et al., 2014; Benuto et al., 2020).

Addressing these issues requires a cultural shift toward more inclusive, supportive academic environments. Institutions must foster healthier professional relationships, reduce stigma around non-academic pursuits, and prioritize trainee wellbeing to create a more sustainable and equitable academic culture.

Mental health challenges

Mental health concerns, particularly stress, burnout, and isolation, were prevalent across individual, interpersonal, and institutional levels of the SEM. These challenges stem from a complex interplay of factors, underscoring the urgent need for systemic support. A key contributor is the unstructured nature of academic work, which often leads to irregular hours and poor work-life balance, conditions well-documented to negatively impact mental health (Pitt et al., 2021).

Trainees also reported heightened anxiety related to societal expectations and peer comparison, further exacerbating psychological distress (Parkman, 2016). Imposter syndrome remains a pervasive issue, compounding stress and self-doubt. The competitive and isolating culture of academia intensifies these struggles, with academic

isolation linked to significant emotional and psychological harm (Wang et al., 2017). The drive to outperform peers often undermines collegiality, contributing to increased anxiety and diminished wellbeing (Hammoudi Halat et al., 2023).

Mental health concerns were closely intertwined with financial, logistical, and cultural stressors, highlighting the interconnected nature of these challenges and the need for comprehensive, multi-level interventions. While many challenges were identified at the individual level, solutions are rarely effective when focused solely on the individual. Instead, systemic changes are essential (Mantri et al., 2021). Institutions must prioritize mental health by expanding access to counseling services, fostering peer support networks, and implementing proactive policies that promote work-life balance and reduce systemic stressors. In addition, institutions should address structural contributors such as administrative burden and rigid hierarchies, and create meaningful opportunities for connection and community-building within academic environments (Mantri et al., 2021).

Implications

Many of these complex challenges faced by research trainees persist into their early-career stages, affecting their long-term research sustainability (Hewko et al., 2024). Addressing these challenges is critical and requires a holistic, multi-level approach across the SEM, targeting Financial, Logistical, Cultural, and Mental Health Challenges. Economic instability calls for policy reforms to raise stipends and introduce flexible funding. Logistical barriers require structural changes that improve work-life balance and access to sustainable careers. Cultural shifts must ease productivity pressures and promote inclusive, supportive environments. Tailored mental health interventions are also essential to address stressors such as imposter syndrome and burnout. A coordinated, systemic response is vital to building a sustainable, equitable academic ecosystem that supports trainee wellbeing and success.

Limitations

The lack of participation from principal investigators, supervisors, and post-graduate scientists, who may have contributed broader systemic or policy-level insights, was a limitation of this study. As a result, the challenges identified predominantly emphasize individual, interpersonal, and institutional-level challenges, while community and policy challenges received less attention. Additionally, focusing solely on Canadian research trainees in SCI may have excluded critical perspectives from other key interest groups that play a pivotal role in shaping the STEM academic environment.

Conclusion

This study highlights the complex Financial, Logistical, Cultural, and Mental Health Challenges faced by research trainees in Canada. Using the SEM, this study highlights how these barriers intersect across multiple levels. The findings underscore the urgent need for multi-level interventions, such as increased funding, clearer career pathways, enhanced mentorship, and cultural shifts that prioritize wellbeing, to support trainee development and ensure a more inclusive, sustainable academic future.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author/s.

Ethics statement

Ethical approval was not required for this study as this conference workshop was designed as a participatory session that gathered insights from workshop attendees on challenges to success faced by Canadian research trainees. This project did not require ethical approval, according to the TriCouncil Policy Statement (TCPS-2, 2022, Article 2.5) and was conducted in accordance with the local legislation and institutional requirements. Attendees provided verbal consent for their written responses to be collected after the workshop and were informed that a publication was planned from workshop learnings, which they were invited to co-author as members of the 10th National SCI Conference Trainee Advisory Group. Participation was entirely voluntary.

Author contributions

NC: Investigation, Data curation, Writing – original draft, Writing – review & editing, Formal analysis, Methodology. EN: Methodology, Writing – original draft, Data curation, Formal analysis, Writing – review & editing, Investigation. LC: Formal analysis, Investigation, Writing – review & editing, Writing – original draft, Data curation, Methodology. TW: Formal analysis, Methodology, Writing – review & editing, Investigation, Writing – original draft, Data curation. GL: Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. AK: Investigation, Writing – original draft, Conceptualization, Supervision, Methodology, Writing – review & editing, Data curation, Formal analysis. WS: Conceptualization, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. Trainee Advisory Group: Data curation, Writing – review & editing, Validation.

Group members of 10th National SCI Conference Trainee Advisory Group

The names and affiliations of the group members are listed in [Supplementary Table 2](#).

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was not used in the creation of this manuscript.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2026.1667667/full#supplementary-material>

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