DMJ

Dalhousie Medical Journal

Volume 48 | No.2

Spring 2022

DMJ
Dalhousie Medical Journal

Editorial Staff

Editor-in-Chief
Mohammad Sultan (Class of 2024)

Associate Editors
Brianne Cruickshank (Class of 2023)
Emily Poole (Class of 2023)
Gavin Lifman (Class of 2023)
Abbey MacLellan (Class of 2024)
Grace Power (Class of 2024)
Ahmed Hussin (Class of 2025)
Mary Fay (Class of 2025)
Amanda Vandewint (Class of 2025)

Humanities Editors
Christopher O'Grady (Class of 2023)
Gaurav Arora (Class of 2025)

DMNB Liason Editor
Ali Sherazi (Class of 2025)

Layout Editor
Kevin Telfer (Class of 2024)

Web Editor
David Hodgson (Class of 2023)

Dalhousie Medical Journal
Box 201, Sir Charles Tupper Medical Building, Dalhousie University
Halifax, Nova Scotia, B3H 4R2
dmj@dal.ca
www.dal.ca/dmj

DMJ is supported in part by the Dalhousie Medical Student Society.

All articles published, including editorials, represent the opinions of the authors and do not reflect the policy of the DMJ Editorial Board, Dalhousie University, or the institution with which the author is affiliated, unless this is clearly specified. Neither the members of the Editorial Board of this journal, the publisher, nor Dalhousie University assume any responsibility for errors or omissions in this journal.

Copyright © 2022, DMJ Editorial Board
All rights reserved. Reproduction without permission is prohibited.

ISNN 1488-9994
Publication Agreement number 4006-9552

EDITOR'S MESSAGE

The impact of the COVID-19 pandemic on medical research

Mohammad Sultan, PhD[1]

1. Faculty of Medicine, Dalhousie University

On March 11th, 2020, the World Health organization declared COVID-19 as a worldwide pandemic. More than two years later, the world is still dealing with ongoing cases on daily a basis. Over 6 million deaths were attributed to COVID-19. The world economy was paralyzed, borders were closed, and the healthcare system was put to the test. In addition to the heroic efforts of the medical teams, other soldiers were working behind the scenes relentlessly to develop vaccines and treatments to use in the war against the virus.

The vaccine implementation helped in decreasing the virus impact as we saw new variants with decreased virulence1. As vaccines continue to be developed, it is essential to take a look at the impact of the pandemic on medical research to understand some of the outcomes we are beginning to see now.

As expected with the emerge of the COVID-19 virus there was a surge in virology research. Hundreds of thousands of papers were published in 2020 and 2021 about the virus and its impact on every aspect of health and life2. While these numbers are expected to decline in 2022, we are beginning to see many reports highlighting the disruption caused by in the pandemic in other areas of medical research. A recent report by the American Association of Cancer Research, have shown that 99% of surveyed researchers indicated that the pandemic has disrupted their research and/or their clinical practice. The same report highlights similar effects on cancer screening and treatment3.

The pandemic also redefined clinical trials. In the early stages, recruitment was paused for many trials that were just starting. Follow up appointments were moved to telehealth, travel restriction was implemented and measures were taken to limit the spread of the virus. However, given the lack of knowledge of the virus transmission and it effects, there were paralyzing fears of spreading the virus among this vulnerable population of patients and their care givers4.

As we move forward, the research world continues to recover from the pandemic effects as researchers learn to carry out their experiments with many new regulations, hoping that will translate to clinical trials resumption and a return to full capacity research. This sentiment is echoed here at the Dalhousie Medical journal as we look forward to more submissions after the marked decrease we observed during the pandemic.

References

1. Miller, I.F., Metcalf, C.JE. Assessing the risk of vaccine-driven virulence evolution in SARS-CoV-2. R Soc Open Sci. 2022 Jan; 9(1): 211021.
2. Brainard, Jeffery. " Pivot into COVID-19 research eases as publishing surge starts to level off". 17 May 2022. <www.science.org/content/article/pivot-covid-19-research-eases-publishing-surge-starts-level> (5 July 2022).
3. American Association for Cancer Research."AACR Report on the Impact of COVID-19 on Cancer Research and Patient Care." 09 February 2022. https://www.AACR.org/COVIDReport (5 July 2022).
4. Ledford, Heidi. "The COVID pandemic's lingering impact on clinical trials". 28 June 2021. <www.nature.com/articles/d41586-021-01569-9> (5 July 2021).

DALHOUSIE
MEDICAL SCHOOL

From **neuroscience** to **vaccinology**, **cancer research** to **drug development,** Dalhousie Medicine is a major contributor to the world's medical knowledge. Our research ensures the latest technologies and treatments are available now.

DALHOUSIE
UNIVERSITY
FACULTY OF MEDICINE

ORIGINAL RESEARCH

A youthful take on community-based healthcare

Hannah Cameron, BSW[1], Connor Bray, MD[2], Tania Wong, MD, MSc[2], Kim Blake, MD[2]

1. Faculty of Medicine, Dalhousie University
2. Department of Pediatrics, IWK Health Centre

Abstract

Youth are at a unique developmental stage, presenting with experiences and needs that can be challenging to address through traditional medical models. Youth health clinics (YHCs) have taken varying approaches to solving this problem; however, there is a paucity of research on adolescents' perspectives of these clinics.

We conducted four focus groups to ask high school students how YHCs could better serve them. Participants identified five essential elements for YHCs. They requested accessibility, reliability, and confidentiality, desiring private access with trusted healthcare professionals that was simple to access. They also emphasized the importance of a range of point-of-care services and proactive advertising of YHC services. Finally, youth prioritized mental health services that were both longitudinal and equipped for crises. Overall, our cohort of youth felt that YHCs could fill an important gap in meeting their healthcare needs.

Background

Youth are at a developmental stage marked by unique experiences and challenges. With a desire for autonomy and privacy, they can find themselves without accessible, comfortable, and effective healthcare[1].

Youth health clinics (YHCs) gained popularity in the United States in an effort to increase adolescent access to healthcare[2]. Reductions in teenage pregnancy achieved by early reproductive health-focused clinics lead to a proliferation of general health clinics in schools. In Canada, YHCs have produced success in urban and rural areas, including communities within Nova Scotia[3]. Halifax is a medium-sized city with an overburdened emergency care system[4]. The emergency system relies on patient self-referral and can fail to treat the most at-risk and difficult to reach youth and their families[5]. YHCs have been found to decrease emergency department (ED) use by youth[6], and broader implementation has the potential to reduce the stress on EDs both at the point of care and by providing preventative care before emergent health problems develop.

YHCs have been lauded for giving timely care that is more accessible than traditional health resources[7]. Adolescents have reported finding YHCs private and confidential[8]. YHCs provide an opportunity for youth to have their healthcare needs met in a familiar environment. Parents have reported greater satisfaction with YHCs, citing increased interactions with doctors and increased time for discussion as major benefits[9].

Young voices are needed to direct the future of YHCs in Nova Scotia. Clinics have been primarily designed by healthcare providers and administrators, lacking input from the patient population. Recent first-voice publications on virtual care have reinforced the need for youth perspectives to better understand and serve youth needs[10].

Methods

Overview

This study used in-depth semi-structured focus groups with high school students living in the Halifax area. Transcripts were analyzed using inductive thematic analysis. This format was selected to recruit a reasonable number of participants at multiple schools. Ethics approval was obtained from the IWK institutional research ethics board (#1023293) and Halifax Regional Centre for Education (HRCE). Parental/guardian consent was obtained for all participants.

Participants

Study participants were high school students aged 14-18 that regularly attended a high school in urban Halifax or the surrounding rural areas. Age, local high school attendance, and English speaking ability were inclusion criteria. Participants were recruited through schools and academic community programs with the aid of community partners. Participants and their guardians provided written informed consent on the day of the focus group.

Survey

Participants were invited to complete a written intake survey that collected data about demographics, healthcare utilization, and self-assessments of health knowledge.

Interviews

Focus groups of 8 participants each were conducted in private spaces in schools and community centres in June 2018 by one author. The four focus groups represented one large urban high school and three high schools with suburban and rural catchment areas. Questions (Table 1) were answered in an informal group conversation lasting between 60 and 90 minutes. Questions were developed by adapting surveys from prior literature on youth focus groups for healthcare planning[11,12]. The questions were developed to elicit local answers and obtain practical suggestions for implementation of YHCs in Nova Scotia. School and community centre staff were on site in case of adverse events. Participants received gift cards as remuneration for participation.

Analysis

Entire sessions were recorded and transcribed verbatim and anonymized. Initial transcripts underwent coding and inductive thematic analysis, with saturation achieved by analysis of the fourth group. Coding and analysis were done independently by two researchers (H.C. and C.B.), then discussed to consensus[13]. Statements of significance were extracted from transcripts. Survey data was compiled quantitatively to describe the study population.

Results

Demographics

A total of 28 youth (n=28) participated in four focus groups. Participant age ranged from 15-18 years, with an average age of 16.7 years. Participants identified primarily as female (79%), heterosexual (75%), and White (54%), with grade averages between 60 and 79 (64%). Note: Participants were able to select multiple answers. Categories with zero responses were not included in table. No adverse events were noted by or reported to researchers.

Themes Arising from Focus Groups

Accessibility

Youth described accessing healthcare services as overwhelming. They wanted a YHC that would not require fees, parental involvement, or frequent referrals to other points of care. Many expressed a preference for a drop-in model and a variety of opening hours, citing wait times as a major deterrent. One participant described their existing YHC as:

> *"One of the reasons that I like this [YHC] so much is I can literally just drop by in the ten minutes in between classes."*

> *"Someone constantly, not just like a certain amount of times of the week ... that's not how it works, I don't decide when I'm sad."*

Confidentiality

A common sentiment was that privacy from both parents and peers would be critical for the success of the clinic. Some participants suggested that the clinic be located far from high traffic areas, while others felt that locating clinics within nearby community centres would generate anonymity and thereby less stigma. One felt,

> *"[A nearby community centre] would definitely be a good place to have it, and it's open and it's friendly and if you care about your reputation you won't lose it if you go there."*

Table 1. Question Route.

1. Do you think that being 'healthy' means something different for teenagers than it does for children or adults?
2. What can a teenager do to maintain their health?
3. What health resources do you know about in your community (outside of the hospital)?
4. What health resources have you heard of your peers using in the past?
5. What resources do you think could benefit your classmate or peers' health?
6. Where would you like these resources to be available?
7. When would you like these services to be provided?
8. Who would you like to provide these services?
9. Do you think that having a clinic in your school would be helpful?
10. What services would you like a youth health clinic to provide?
11. What would make you more likely to use one of the services we've discussed?
12. What would make you less likely to use one of the services we've discussed?

Table 2. Participant Demographics.

Variable	Answer	# of Answers
Age	15	3
	16	10
	17	8
	18	7
Gender	Female	22
	Male	6
	Trans*	1
Sexuality	Heterosexual/Straight	21
	Homosexual/Gay/Lesbian	2
	Bisexual	3
	Pansexual	1
	Not Specified	1
Race	White	17
	Black	7
	Indigenous	6
	Not Specified	1
Grade Average	50-59%	1
	60-69%	9
	70-79%	9
	80-100%	7
	Not Specified	1
Last Visit to Family Doctor	<1 month	7
	<6 months	9
	<1 year	7
	>1 year	3
	Not Specified	2

> *"... one of the things that would make me less likely to go, is like if I were to get my parents involved with [the healthcare provider], because it's kind of like confidentiality between me and [the healthcare provider], so kind of like getting them involved would suck, until it gets serious."*

Relatability

Participants expressed a preference for known adults when seeking care. Some suggested that clinic staff introduce themselves at a school assembly so students could know who they would see in the clinic. Youth consistently wanted to feel comfortable with their health care providers. They identified that many patients would prefer a healthcare professional of the same gender. Participants also felt more comfortable talking to a member of the LGBTQ+ community if they identified as such.

> *"...having more diverse people on staff makes it more accessible to people who don't feel like they're outing themselves, or putting themselves in danger when they're talking to these people."*

Some participants who were members of racial or religious minorities expressed concern about how healthcare providers could understand their experiences. Participants who had pre-existing relationships with elders or religious leaders in their community valued connecting over shared experience.

> *"... he could literally be the nicest person on earth, and I still wouldn't go probably, because there is no connection whatsoever. He is literally the opposite in almost every way, it just doesn't feel comfortable."*

Outreach

Many participants had only a vague idea of the roles of different healthcare professionals and how to access them. Most relied on known adults for information.

> *"I've heard of some of my friends coming to see the youth health centre nurse, I've heard of them going to see a duty doctor to get prescribed, [or] a pharmacist, I've heard of them going to a police station to get help."*

Participants suspected that typical methods such as posters and announcements could bolster awareness, and that assembly-style presentations from care providers could help youth know who and what to expect when accessing a clinic, making it less intimidating.

> *"... it doesn't matter how many resources you have, if no one knows about it, no one's going to use them."*

Mental health

Participants referenced several age-related stressors which they believed increased their susceptibility to mental health concerns. Some of these stressors were more autonomy in their lives, more challenging and consequential schoolwork, planning for university and careers, body image, and romantic relationships.

Participants hoped that a YHC would provide a supportive outlet for them to discuss mental health concerns. Some feared that their current resources may not be equipped to handle high acuity mental health needs.

> *"Not everybody has friends or close people they can talk to, so having an anonymous stranger without*

> *bias to talk to is really helpful."*

Some youth felt that they were forced to act as mental health supports for friends who had no other options despite feeling ill-equipped to handle these issues. This subsequently impacted the supportive friends' mental health and they described wanting to alleviate this burden by having a convenient way to access professional help for their friends.

> *"…they're coming to you and there is nothing you can do and it piles up on you because you can't help them and you feel worse than you already did."*

Broad services

Participants desired an expanded scope of practice at point of care. Their schools primarily offered preventative health and education in existing health centres. Participants asked for testing, diagnosis, prescription, and dispensing all available on-site.

> *"Being able to prescribe something like contraceptive birth control, or pain medication, or like Advil, or even if someone needed something for depression… on top of being able to diagnose ailments."*

> *"… instead of just going to one and them like 'I don't know what's wrong with you, I don't know what to do with you, try going somewhere else."*

Aside from medical care, several youth felt that their health would benefit from a greater amount of social programming run through the YHC.

> *"…just knowing that if you don't want to be at home that night, you can go do something and get away from all like the drama at home, or whatever's going on in your life, just go and not have to worry about that."*

Participants advised that offering hygiene products and other necessities would provide an incentive for them to engage with the health centre. They emphasized the importance of the quality of these items as a predictor of uptake and engagement.

> *"… if they need anything they can just go in and grab it, like a mini stick of deodorant or for girls especially like if you need tampons or pads that they're there and they're not like the crappy ones."*

> *"It's a good way to start a conversation, if you have food."*

Participants wanted to contribute to the governance and organization of the clinic, requesting ongoing input into what services are offered and how the clinic operates.

> *"… a way to voice your opinion, then people will feel like they're heard and they don't have to just deal with it."*

They expressed interest in involving many healthcare professionals in varying capacities. Pharmacists, therapists, nurses, doctors and social workers were specifically mentioned. Participants also expressed an interest in care that is privatized in Nova Scotia such as dental, hearing, and vision care, citing a lack of access to these services elsewhere.

Discussion & Recommendations

Overall, young people desire healthcare services that cater to their specific circumstances. Consistent with previous research, participants prioritized accessible and confidential healthcare[8], and generally preferred YHCs to traditional office models, considering them one of a few viable options that could address their priorities for healthcare delivery. These desires are congruent with studies on parental trust in school-based YHCs, with confidentiality and clear communication among the most important contributors to parental trust[14]. Participants expressed surprising and creative ideas for how healthcare could better work for them, findings which highlight the importance of youth voices in health research.

Since this study was conducted, healthcare has evolved dramatically to comply with COVID-19 restrictions through telehealth. Although it was not discussed in our focus groups, telehealth could comply with many of the principles described by participants. Telehealth delivery has the potential to lower barriers to access and improve confidentiality. In person, these two attributes can be difficult to balance. Using virtual methods, youth can receive support from health professionals from anywhere and at a flexible range of times. A YHC with a virtual option can do so without interfacing with a parent, teacher, receptionist, or peer, meeting the need for confidentiality. Although not every consultation or procedure can be completed virtually, the use of telehealth services presents an opportunity to meet youth healthcare needs according to their desires.

A second major priority for adolescents is the creation of lasting relationships between patients and healthcare providers. Participants consistently cited a desire for these relationships as a reason why YHCs appealed to them. Many participants emphasized a need to be "understood" by their healthcare practitioner; this was especially true for youth who come from a demographic group whose healthcare needs have been historically discounted. These experiences are informed by a history of over-medicalization, underrepresentation, and systemic discrimination of minorities in Canadian healthcare15. While changing the demographic identity of the physician workforce is not a short-term project, these barriers can and should be addressed in other ways. Physicians must demonstrate their commitment to learning from and growing with historically underserved populations. YHCs can bring continuity and familiarity to patient-healthcare relationships, attributes which extend into virtual healthcare when circumstances demand. This may have been a contributor to prior studies' findings of reduced disparities in health-seeking behaviour associated with race and socioeconomic status when students had access to YHCs[16].

A final priority established by the results was access to mental health care for students, as well as resources for peer support. Participants expressed feeling a need to support their own friends, without any formal training, while needing support themselves. In the context of the COVID-19 pandemic, these experiences have likely evolved. Fear of infection, loss of independence, family financial struggles, and social isolation have been shown to cause psychological distress in young people during COVID-19[17]. Youth need mental health supports that will address their reactions in a social context and take the strain off informal peer-support networks. As we have seen in-person schooling quickly shift to virtual school, YHCs can pivot in a similar manner to provide consistent support, providing a crucial resource for reaching youth at home.

As societal healthcare norms continue to evolve, youth will continue to present with unique needs and desires. YHCs present an effective option to meet the expressed needs of high school students in the Halifax region. They address accessibility, continuity of relationships, and the possibility of integrated mental health support in adolescents' daily lives. Given the shortage of primary healthcare physicians in Nova Scotia, YHCs may be able to reach populations in ways that office-based medicine cannot. By designing YHCs in collaboration with youth, healthcare providers can better integrate healthcare into community and see the ongoing results of their work. Future research can explore the efficacy of YHCs after their implementation, with program evaluations to continuously improve healthcare delivery. This study was limited by geographic area and the local nature of the questions. Future research could apply this model to other communities, potentially focusing on non-English-speaking youth or youth with special healthcare needs, or expand the question route to solicit perspectives on care delivery on a broader level. Lastly, in light of the COVID-19 pandemic, future research could explore youth perceptions and experiences of virtual care delivery and perspectives on expansion.

References

1. Miller, M.K., Wickliffe, J., Jahnke, S., Linebarger, J.S., Dowd, D. Accessing general and sexual healthcare: Experiences of urban youth. Vulnerable Child Youth Stud 2014; 9(3): 279-290. https://doi.org/10.1080/17450128.2014.925170
2. Ethier, K.A. et al. School-based health center access, reproductive health care, and contraceptive use among sexually experienced high school students. J Adolescent Health 2011; 48(2011): 562-565. https://doi.org/10.1016/j.jadohealth.2011.01.018
3. Gahagan, J.C., Jason, T., Leduc, D. Does grade level relate to school-based youth health center utilization among male youth? Quantitative findings from a mixed-methods study in Nova Scotia, Canada. J School Health 2012; 82(8): 387-394. https://doi.org/10.1111/j.1746-1561.2012.00714.x
4. Laroche, J. "Head of Nova Scotia's ambulance service sounds alarm over own system". 2018 Nov 22. www.cbc.ca/news/canada/nova-scotia/ambulance-service-system-emergency-ehs-emergency-health-services-1.4914789 (Jan 27, 2022).
5. Pellerin, K.A., Costa, N.M., Weems, C.F., Dalton, R.F. An examination of treatment completers and non-completers at a child and adolescent community mental health clinic. Community Ment Hlt J 2010; 46: 273-281. https://doi.org/10.1007/s10597-009-9285-5
6. Knopf, J.A. et al. School-based health centers to advance health equity. Am J Prev Med 2016; 51(1): 114-126. https://doi.org/10.1016/j.amepre.2016.01.009
7. Sabharwal, M., Masinter, L., Weaver, K.N. Examining time to treatment and the role of school-based health centers in a school-based sexually transmitted infection program. J School Health 2018; 88(8): 590-595. https://doi.org/10.1111/josh.12648
8. Denny, S. et al. Access to private and confidential health care among secondary school students in New Zealand. J Adolescent Health 2012; 51(2012): 285-291. https://doi.org/10.1016/j.jadohealth.2011.12.020
9. Alleyne, S., Nussbaum, A., Smotherman, C.R., Lukens-Bull, K., Cuffe, S.P. Parents' satisfaction with a school-based mental health clinic versus traditional outpatient clinics. J Am Acad Child Psy 2018; 57(10S), S266. https://doi.org/10.1016/j.jaac.2018.09.415
10. Fletcher, S.E., Tsang, V.W.L. The era of virtual care: Perspectives of youth on virtual appointments in COVID-19 and beyond. Paediatr Child Health 2021; 26(4): 210–213. https://doi.org/10.1093/pch/pxaa138
11. Ensign, J. Quality of youth health care: The views of homeless youth. Health Serv Res 2004, 39(4): 695-708. https://doi.org/10.1111/j.1475-6773.2004.00253.x
12. Garland, A.F., Saltzman, M.D., Aarons, G.A. Adolescent satisfaction with mental health services: Development of a multidimensional scale. Eval Program Plan 2000; 23(2000): 165-175. https://doi.org/10.1016/S0149-7189(00)00009-4
13. Braun, V., Clarke, V. Using thematic analysis in psychology. Qual Res Psychol 2006; 3(2): 77-101. https://doi.org/10.1191/1478088706qp063oa

14. Nahum, A.S., Vongsachang, H., Friedman, D.S., Collins, M.E. Parental trust in school-based health care: A systematic review. J School Health 2022; 92(1):79–91. https://doi.org/10.1111/josh.13106
15. Waldron, I.R.G. The impact of inequality on health in Canada: A multi-dimensional framework. Divers Health Care 2010; 7: 261-270. https://www.primescholars.com/articles/the-impact-of-inequality-on-health-in-canada-a-multidimensional-framework-94620.html
16. Kratzke, C., Rao, S., Marquez, R. Ethnic differences for public health knowledge, health advocacy skills, and health information seeking among high school students: Community agents of change. J Commun Health 2018; 43: 874-881. https://doi.org/10.1007/s10900-018-0496-y
17. Brooks, S.K. et al. The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. Lancet 2020; 395: 912-920. https://doi.org/10.1016/S0140-6736(20)30460-8

ORIGINAL RESEARCH

Recent medical graduates' attitudes towards nutrition education and its role in medical practice

Lydia Melanson, BSc, MD[1], Diane Ramsay, MSc, MD[1], Olga Theou, PhD[1,3], Peri Fenwick, MD[1], Alyson Colborne, MD[1], Leah Cahill, PhD[1,2]

1. Department of Medicine, Dalhousie University
2. Department of Nutrition, Harvard T. H. Chan School of Public Health
3. School of Physiotherapy, Dalhousie University

Abstract

The objective of this study was to investigate recent Dalhousie Medical School graduates' perceptions of nutrition in three domains: attitudes towards its use in medical practice generally, learned body of knowledge in medical school and residency, and satisfaction with how undergraduate and postgraduate medical education aligned their attitudes and knowledge of nutrition in medicine.

Graduates of Dalhousie University's undergraduate medical program from 2013 to 2018 were contacted to complete an internet-based questionnaire of 13 five-point Likert scale questions about attitudes, knowledge, and satisfaction with nutrition education in their undergraduate medical studies and medical practice. Responses ranged from one, "strongly disagree" to five, "strongly agree".

Most respondents (90.2%) agreed that 'nutrition counseling can make a positive difference to patient outcomes' and 80.5% agreed that 'physicians can influence patient behavior related to nutrition'. However, fewer (61.0%) agreed that 'physicians play a key role in improving patients' nutritional habits.' Even fewer participants agreed that nutritional assessment (34.1%) and nutritional counselling (41.5%) should be a routine part of care, regardless of specialty. The mean (standard deviation) overall score of participants with regards to their attitudes about nutrition assessment, counselling, and role in patient health, was 3.60 (0.633). Scores ranged from 1 to 5 with higher score indicating more positive attitude. Mean overall knowledge and satisfaction scores were 3.76 (0.702) and 2.70 (0.898), respectively.

There is a lack of consensus regarding the role of physicians in delivering nutrition care to patients, despite its perceived importance to patient health, requiring further exploration.

Introduction

The prevalence of noncommunicable diseases as a result of poor diet and obesity has increased significantly in recent years, contributing to rising healthcare expenditures, morbidity, and mortality [1,2]. Diet was ranked in second most influential risk factor contributing to disability-adjusted life years in Canada as of 2016 [3]. Developed countries have witnessed unprecedented rises in chronic diseases such as cardiovascular disease and diabetes, which are known to be mediated largely by modifiable lifestyle factors [2]. Lifestyle interventions are effective for the prevention and first-line management of chronic disease, or as adjuncts to other medical treatments [4–7]. The etiology of obesity and other chronic diseases is multifaceted, requiring intervention from healthcare providers at the level of individual patients as well as public policy [8,9].

It is well-recognized that diet has a fundamental role in health and disease; therefore, most physicians identify nutrition counseling as one of their major professional responsibilities [10–12]. There is evidence that doctors have the ability to improve nutrition behaviours of patients who have, or are at risk of developing, chronic diseases related to lifestyle factors [13]. Patients entrust their doctors with the task of addressing lifestyle influences such as diet and expect to receive counsel that is current and reliable [14,15]. Despite this, physicians have consistently reported low rates of counselling patients about lifestyle [10,16,17]. Rates of malnutrition in Canadian hospitals is high, and malnutrition often goes unrecognized by medical professionals [18,19]. A Canadian survey reported that physicians believe hospital inpatients should have nutrition assessments performed throughout their hospitalization; however, most reported that these assessments were being completed inconsistently [19]. The consequences of this reality are increased length of hospital stay [18], worsened patient outcomes, and elevated costs of care [20].

Barriers to nutrition counselling have been commonly cited by physicians, including insufficient time, lack of reimbursement, a perception that lifestyle counselling is ineffective, and a deficiency of knowledge and confidence in the subject matter [17]. A Canadian study showed that physicians had an average self-assessed clinical nutrition knowledge of 5.3 on a scale of 1 to 10 [19]. Certain medical subspecialties provide more nutritional training than others; however, practicing physicians and trainees in these fields often perceive a deficit in one or more areas of their training in nutrition [11,21,22].

A 2010 survey of Canadian medical students reported that 87.2% of participants thought their program should devote more time to teaching nutrition concepts [23]. Of the nine medical schools that Gramlich surveyed in 2010, students of Dalhousie were from one of two schools self-reporting the lowest number of hours devoted to education in their curriculum. Recent studies investigating nutrition education in Dalhousie's undergraduate medical program reveal that students are still not satisfied with the amount of nutrition education they have received since Gramlich's 2010 study[23–25].

While other researchers have explored the nutrition knowledge and attitudes of Canadian medical residents [11,26], these studies have fixated on residents of one subspecialty. Instead, we hope to draw comparisons between residents of different programs who had received the same baseline level of nutrition education in their undergraduate medicine program.

Objectives

The objective of the present study was to determine Dalhousie Medical School graduates' perceptions of nutrition in three domains: their attitudes towards its use in medical practice generally, their learned body of knowledge in medical school and residency, and their satisfaction with how their undergraduate and postgraduate medical education aligned to their attitudes and knowledge of nutrition in medicine [25].

Materials and Methods

Study design

The study design for this project was cross-sectional and conducted using a web-based questionnaire. The participants were recent Dalhousie medical graduates from 2013 through 2018. The study population includes participants from a range of specialties and levels of experience. The pool from which participants were drawn consisted of 685 Dalhousie medical graduates from the graduation years of interest.

The questionnaire was reviewed independently in a face and content validation by clinicians and by researchers with a significant background in nutrition and physical activity research. The questions were organized into three domains: attitudes about nutrition in medical practice, knowledge about nutrition concepts in medicine, and satisfaction with nutrition education received in medical school and residency programs. Demographics, including gender, medical subspecialty, and previous education in nutrition and/or physical activity were also collected. Attitudes, knowledge, and satisfaction with physical activity education in medical school and residency were addressed in subsequent sections, and these data will be reported and analyzed in a separate publication. Questions were designed to facilitate responses on a 5-point Likert scale with the following options: strongly disagree, disagree, neither agree or disagree, agree, or strongly agree. Participants had the option to leave additional comments, which would not be formally analyzed, but used in discussion of the study results. The questionnaire domains were analyzed based on the level of agreement with each statement and are summarized in table 1.

The research tool was administered through a secure online survey platform, Opinio version 7.11, which was emailed to Dalhousie Medical Alumni Association (DMAA) from graduating years 2013 through 2018 via the DMAA Listserv. DMAA administration were responsible for the dissemination of the email to preserve the anonymity of eligible participants. The survey was also shared to a private social media group whose membership consists of Dalhousie medical alumni. A cover letter described the nature and purpose of the study, and detailed the components of consent, privacy, confidentiality, and contact information for the lead researchers. The survey design and study were approved by the Dalhousie University Research and Ethics Board in May 2019.

Data was analyzed using SPSS software version 25 (IBM, Armonk, NY). Descriptive statistics (means/standard deviations and medians/interquartile ranges [continuous variables] and counts/percentages [categorical variables]) were used to summarize survey responses and participant characteristics. According to the 5-point Likert scale percentage agreement was analyzed, with a score of 4 (agree) or 5 (strongly agree) indicating agreement, a score of 3 indicating a neutral response, and a score of 1 (strongly disagree) or 2 (disagree) indicating disagreement. Independent samples T-tests were used to compare the results between those with and without previous nutrition education, males and females, and to compare current residents with those who had already completed residency. The scores from each domain (attitudes, knowledge, and satisfaction) were then combined and an average score was determined for each domain. Normality was confirmed for the data in each domain with the Shapiro-Wilk test of normality. Pearson correlation tests were used to

Table 1. Study questionnaire domains and statements.

Domain	Statements
Questions regarding nutrition attitudes	*"Nutritional counselling can make a positive difference to patient health outcomes."*
	"Physicians play a key role in improving patients' nutritional habits."
	"Nutritional assessment should be part of routine care by all physicians, regardless of specialty."
	"Nutritional counselling should be part of routine care by all physicians, regardless of specialty."
	"Physicians can influence patient behaviour related to nutrition."
Questions regarding nutrition knowledge	*"I know basic nutrition concepts." (i.e. types of macro and micronutrients)*
	"I understand the role of nutrition in the pathophysiology of specific diseases." (i.e. cancer, cardiovascular, respiratory diseases)
	"I understand the role of nutrition in the treatment of disease." (i.e. nutrition recommendations to lower cholesterol levels)
	"I know how and where to access credible nutrition information and/or resources." (i.e. Canada's Food Guide, Harvard Nutrition Source, a registered dietitian)
Questions regarding satisfaction with nutrition education	*"The amount of time dedicated to nutrition education in my medical education and residency training seems appropriate."*
	"Nutrition education is/was well integrated into various aspects of my curriculum."
	"My medical education and residency training in terms of nutrition has prepared me for my career as a physician."
	"I feel that I am able to provide my patients with adequate nutritional counselling."

assess the relationships between attitudes, knowledge, and satisfaction. The significance level for all tests was set at $\alpha \leq 0.05$.

Results

Respondent characteristics

Of the 685 eligible Dalhousie Medical graduates who were contacted, a total of 53 individuals participated in the questionnaire, of which 12 participants did not complete the demographics section and were excluded from analysis (table 2). A broad range of specialties were represented, but Family Medicine comprised the majority (56.1%) of respondents. Resident physicians made up 58.5% of the responses, and attending physicians encompassed the remaining participants. Over half of the survey respondents were female (68.3%) and 22% of study participants reported previous nutrition education, including nutrition research, university nutrition courses, clinical nutrition experiences, and independent study (defined as "other").

Attitudes regarding nutrition in medical practice

There were five statements reflecting positive attitudes towards nutrition in health, as well as nutrition assessment and counselling in medical practice, for which the participant responses could range from strongly disagree to agree on a scale of 1 to 5. Generally, respondents agreed with these statements, resulting in an average mean domain response of 3.60 (+/- 0.633). Respondents most strongly agreed (90.2%) with the statement that, "Nutrition counselling can make a positive difference to patient health outcomes", and zero responses indicating disagreement (Figure 1). The questions exploring physician roles in nutrition care for patients yielded more variability. Regarding routine nutrition counselling by physicians of any specialty, only 41.5% of participants agreed, while 36.6% disagreed that it should take place. "Nutritional assessment should be a routine part of care by all physicians, regardless of specialty", was met predominantly with disagreement (46.3%) or neutrality (19.5%). Most physicians agreed (80.5%), however, that they are able to influence patient's nutrition behaviours (Figure 1).

Self-perceived nutrition knowledge of new physicians

This section of the questionnaire yielded the most positive responses from study participants. Among all four questions in this category, none of the respondents selected, "strongly disagree". The first statement, "I know basic nutrition concepts", resulted in the highest level of agreement (85.4%). The lowest level of agreement (61%) was produced for the statement, "I understand the role of nutrition in the pathophysiology of specific diseases". Participants expressed more confidence in their knowledge of the role of nutrition in the treatment of disease with 68.3% in agreement, as well as where they could look to find credible nutrition information, for which 80.5% of respondents agreed (Figure 1).

Table 2. Characteristics of study participants.

Demographic Characteristics	No. (%)
Gender	
Female	28 (68.3)
Male	13 (31.7)
Previous nutrition education *	
Yes	10 (24.4)
No	29 (70.7)
Other	2 (4.9)
Current medical resident	
Yes	24 (58.5)
No	17 (41.5)
Current or previous residency specialty	
Family	23 (56.1)
Other **	18 (43.9)

** Degree in nutrition or related field, Nutrition research, Nutrition course(s) post-high school, Clinical experience; Other.*

*** Anaesthesiology, Dermatology, Internal Medicine including subspecialties, Neurology, Pathology, Pediatrics, Physical Medicine and Rehabilitation, Psychiatry, and Surgery.*

Perceived adequacy of nutrition education in medical school and residency training

The average mean satisfaction with nutrition education in medical school and residency was low (2.70 +/- 0.898). Three of four statements in this category generated mainly negative responses. Only 26.9% of study participants felt that their nutrition education in medical school and residency prepared them for their career, and furthermore, 58.5% felt that this aspect of their education was poorly integrated into the curriculum. Just 37.5% of participants agreed that they were able to provide their patients with adequate nutrition counselling (Figure 2).

Effect of demographic characteristics on survey responses

Demographic characteristics were explored for their effects on questionnaire responses, including previous participant nutrition education (yes or no), medical specialty (family medicine or other), and current medical residents versus physicians who had completed residency training. There were no significant differences in the responses between genders (Figure 3), status of nutrition education prior to medical school (figure 4), nor between family medicine specialists and other medical specialists (Figure 5). There was only one question demonstrating a significant difference between current residents and physicians who had completed residency training (p = 0.005), the latter of whom were more in agreement with the statement, "The amount of time dedicated to nutrition education in my medical education and residency training seems appropriate" (Figure 6).

Correlations between attitudes, knowledge, and satisfaction

The three survey domains of attitudes, knowledge, and satisfaction were compared to determine if there were any correlations between them. There was no significant correlation between attitudes and knowledge (r = 104, p = .517), nor between attitudes and satisfaction (r = -.258, p =.103). However, there was a significant positive correlation between knowledge and satisfaction domains (r = .584, p < 0.001).

Discussion

In this survey, new physicians were largely in agreement that nutrition counselling plays an important role in patient health and that physicians can influence nutrition-related patient behaviours. Concerning more specific responsibilities of physicians, participants rated nutrition assessment as less important than nutrition counselling. Respondents identified their knowledge of basic nutrition concepts to be very strong, regardless of prior education, and yet their understanding of nutrition in the context of disease pathophysiology to be comparatively weaker. Despite this, most participants agreed that they understand the role of nutrition in disease management and where to access relevant and reliable nutrition information. Finally, the perceptions of nutrition education received in medical school and residency were strongly negative, especially regarding the amount of time allotted to nutrition education during medical training. Neither gender, prior nutrition education, medical specialty, nor residency status had a significant impact on participant responses in the three categories being assessed. Those with a higher level of satisfaction with their nutrition training also reported a higher level of nutrition knowledge in the context of medicine, and vice versa.

Compared to a 2018 study of medical students at Dalhousie University, from which the current study was modelled, there were similar results. In terms of attitudes, medical students' responses mirrored those of the new physicians, reflecting the strongest agreement with statements reinforcing the role of nutrition in patient health, and the weakest level of agreement with statements about nutrition counselling and as-

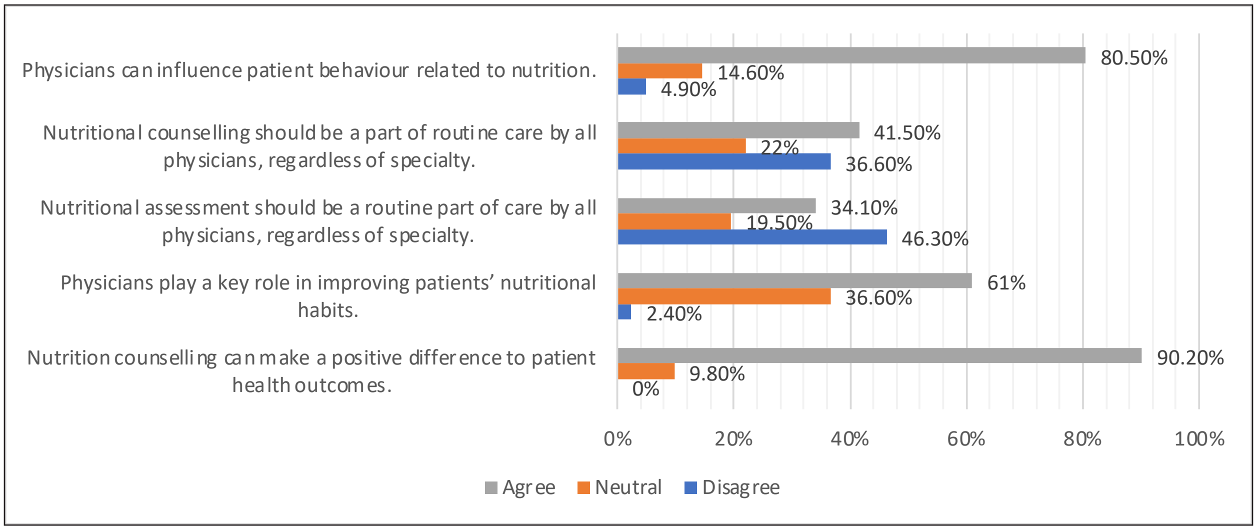

Figure 1. Recent medical school graduates' attitudes towards nutrition in medical and residency education and practice. Percentage agreement was determined according to the 5-point Likert scale, with a score of 5 (strongly agree) or 4 (agree) indicating agreement, a score of 3 (neither agree nor disagree) indicating neutral, and a score of 2 (disagree) or 1 (strongly disagree) indicating disagreement.

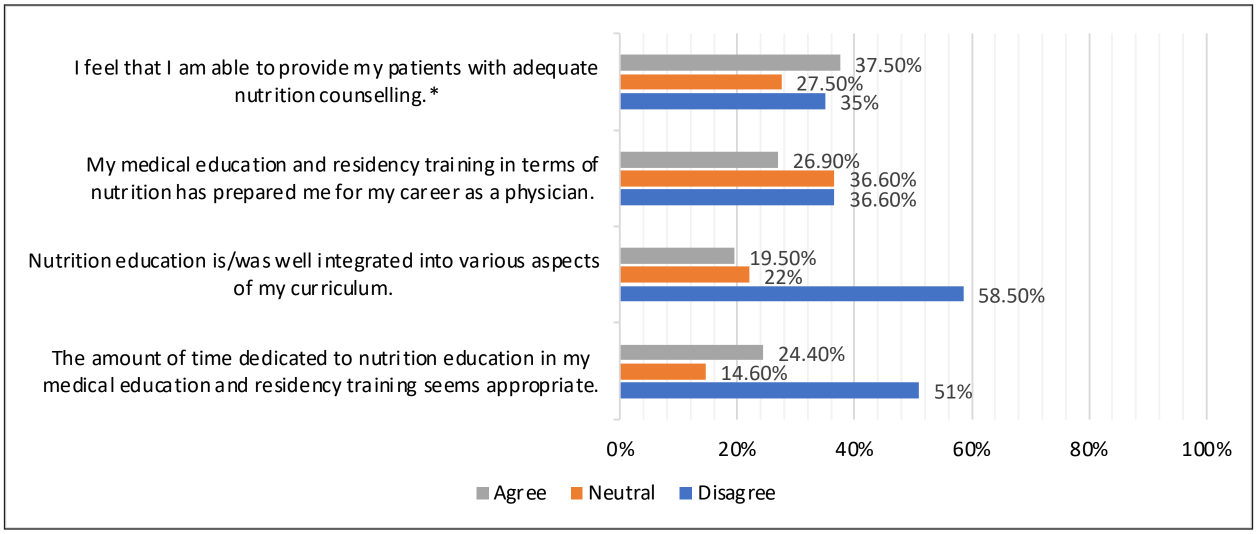

Figure 2. Recent medical school graduates' satisfaction with nutrition education in medical school and residency training. Percentage agreement was determined according to the 5-point Likert scale, with a score of 5 (strongly agree) or 4 (agree) indicating agreement, a score of 3 (neither agree nor disagree) indicating neutral, and a score of 2 (disagree) or 1 (strongly disagree) indicating disagreement.

sessment[25]. Hanninen's study of Dalhousie medical students' perceptions of nutrition curriculum in 2019 also resulted in almost complete agreement that nutrition is important in disease prevention and management and that physicians should be involved in initiatives that promote healthy lifestyles [24].

In 1985 there was a survey of American medical schools which identified inadequate levels of nutrition education being offered in medical curriculums, prompting new recommendations regarding nutrition education hours and outcomes[27]. Despite programming to encourage the adoption of these recommendations, most institutions in the United States to this date do not meet them[28,29]. In Canada, there are also concerns about the amount of nutrition education being offered in undergraduate and postgraduate medical education. Three studies have reported on medical student perceptions of nutrition education at Dalhousie's undergraduate nutrition program, agreeing that there is insufficient nutrition instruction in the curriculum [23,24]. This is consistent with current literature demonstrating a paucity of nutrition education throughout medical school and residency in North American medical education programs [10,26,30–32].

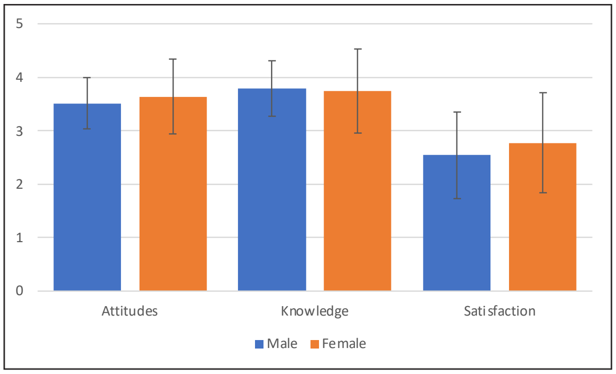

Figure 3. Attitudes, knowledge, and satisfaction among male and female participants. The score for each domain is based on the average 5 point Likert scale (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree). There were no significant differences between either group in any of the domains.

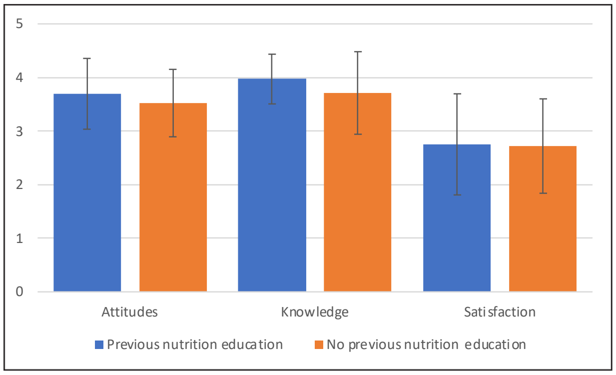

Figure 4. Attitudes, knowledge, and satisfaction between those with previous nutrition education* and those without previous nutrition education. The score for each domain is based on the average 5 point Likert scale (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree). There were no significant differences between either group in any of the domains.*Degree in nutrition or related field; Nutrition research; Nutrition course(s) post-high school; Clinical experience; Other.

Among post-graduate medical trainees, gastroenterologists in Canada have expressed that nutrition training is underemphasized in their programs[33]. Similarly a survey of American cardiologists revealed that 90% of participants did not receive nutrition education during their fellowship [10]. Family medicine residents have also reported barriers to nutrition education with one study reporting lack of time allotted to nutrition, time-constrained faculty, absence of expert faculty, and inconsistencies in the nutrition information they receive[34].

Numerous programs have aimed to address the deficiency of nutrition education during medical training, not limited to interprofessional and integrated curriculums, online modules, and nutrition-focused rotations[21,22,35]. Despite this, there is no consensus on how to improve nutrition education for medical students, trainees, and staff. Mentorship in nutrition throughout training can foster more favourable views of lifestyle counseling among trainees and contribute to higher levels of confidence in performing nutrition counseling with patients[36]. Recommendations from Hanninen's study of Dalhousie medical students, were to introduce longitudinal programming of nutrition materials, utilize dietitians as expert educators, and continue to evaluate and adapt the existing curriculum[24].

Implications and future directions

The results of this study may help determine whether nutrition education in medical school has an impact on future practice and identify areas of nutrition education in medical training which may require further evaluation. The results of the questionnaire and comments made by participants prompt other potential research questions. For example, it may be beneficial to include a nutrition knowledge questionnaire in future studies to objectively evaluate or validate the understanding of physicians regarding important nutrition topics. Furthermore, participants could be questioned regarding what types of learning activities would most benefit them, such as expert mentorship, increased didactic teaching, or interprofessional learning opportunities. One comment, "I don't feel that physicians should be the primary people counselling on nutrition. We have dieticians for this and should use them as adjuncts just like we use physiotherapists or social workers", questions whether physicians are the most qualified persons to offer nutrition advice. Future studies should investigate how physicians and dietitians can collaborate to provide appropriate nutrition care for patients in various settings. Contrasting the results of this questionnaire with actual physician practices, such as time spent nutrition counselling, tests ordered to establish nutrition status, and the number dietitian referrals made, could be valuable. The written comments were extremely interesting to read and a qualitative study on this topic should be considered to account for the nuances of patient care in medicine.

Strengths and weaknesses

The most significant weakness of this study was the small sample size, with only 41 out of 685 eligible individuals participating. Among those who completed the questionnaire, demographic criteria were not equally represented, making it difficult to establish significant differences between groups. These factors limited the statistical analyses which could be performed, and the ability to generalize these results to the larger population. Despite this, the respondents overwhelmingly

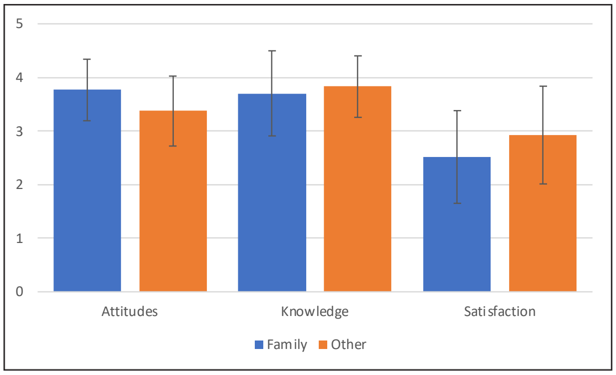

Figure 5. Attitudes, knowledge, and satisfaction between family medicine specialists and other medical specialists*. The score for each domain is based on the average 5 point Likert scale (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree). There were no significant differences between either group in any of the domains. * Other specialists included: Anaesthesiology, Dermatology, Internal Medicine including subspecialties, Neurology, Pathology, Pediatrics, Physical Medicine and Rehabilitation, Psychiatry, and Surgery.

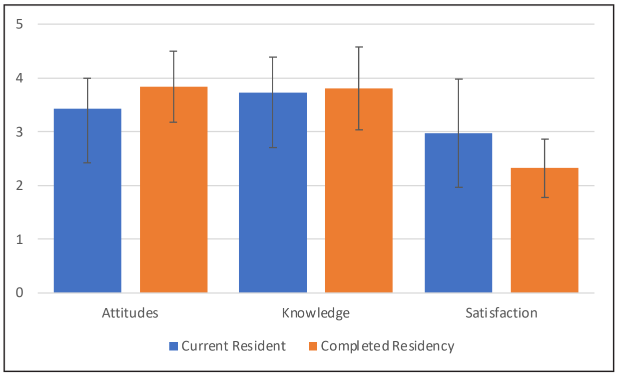

Figure 6. Attitudes, knowledge, and satisfaction between current residents and physicians who had completed residency. The score for each domain is based on the average 5 point Likert scale (1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree). There were no significant differences between either group in any of the domains

agreed that nutrition is important to patient health and that physicians have the power to change patient health behaviors, and the majority disagreed that their nutrition education in medical school was sufficient. While we cannot fully assess the significance of these results, it is reassuring to note that the responses we received are consistent with other studies' findings[24,25]. The study included respondents graduating over a 5-year time period, but the year of graduation was not requested in efforts to protect anonymity; however, this information may have been useful to evaluate how attitudes and perceptions change with practice, and to account for variability in yearly curriculum. Although the sample size was small, it is important to recognize that some medical school graduates had these responses, as the results from this study may inform future research or be used in curriculum planning discussions.

Another weakness of the study was the use of a questionnaire that had not been previously validated. However, the questions were based on a prior study which examined the same parameters among medical students[25]. The inclusion criteria were restricted to graduates of Dalhousie University only, and therefore the results cannot be generalized to other medical school graduates. With greater than 1 out of 5 of participants reporting prior nutrition education and demonstrating greater confidence in their nutrition knowledge, pre-medical school training could have influenced our results; future studies should account for the influence of previous nutrition training.

The major strength of the study was in evaluating these parameters among new physicians, helping to establish whether nutrition education in medical school has an enduring impact on practicing physicians.

Conclusion

The participants had overwhelmingly positive attitudes regarding the role of nutrition in patient health, and the ability of physicians to impact patient nutrition behaviours. While they agreed that physicians do have a role in promoting healthy diet, they were less certain about their role in nutrition assessment and counselling. Overall, participants were dissatisfied with the amount of nutrition education they received throughout their medical education. Future research on the role of physicians in nutrition care, and particularly which types of medical specialists should be engaged most extensively in these practices, is needed so that the nutrition component of the medical school curriculum can be improved for training physicians.

Acknowledgements

This project was completed as part of Dalhousie Medical School's "Research in Medicine" program, through the support of the Dalhousie University Department of Medicine Internal Medicine Research Foundation (UIMRF) Studentship. We sincerely thank the Dalhousie Medical School Alumni Association for distributing the questionnaire, and the participants who completed it.

References

1. Flegel, K., Magner, P. Get excess salt out of our diet. Can Med Assoc J. 2009;180(3):2009.
2. Nudler, E., Gottesman, M.E. Diet, nutrition and the prevention of chronic diseases. World Health Organ Tech Rep Ser. 2003;916(2003):1-149.
3. Alam, S. et al. Assessment of the burden of diseases and injuries attributable to risk factors in Canada from 1990 to 2016: an analysis of the Global Burden of Disease Study. CMAJ Open. 2019;7(1):140-148.
4. Mente, A., de Koning, L., Shannon ,H., Anand, S. A systematic review of the evidence supporting a causal link between dietary factors and coronary heart diseas. Arch Intern Med. 2009;21(3):555-563.
5. Gómez-gracia, E., Ruiz-gutiérrez, V., Fiol, M. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet. N Engl J Med. 2018;378(25):1279-1290.
6. Diabetes Prevention Program Research Group. The Diabetes Prevention Program (DPP): Description of lifestyle intervention. Diabetes Care. 2002;25(12):2165.
7. Appel, L., Moore, T., Obarzanek, E., Vollmer, W., Svetkey, L. A clinical trial of the effects of dietary patterns on blood pressure. N Engl J Med. 1997;336(16):1117-1124.
8. Aspry, K.E., et al. Medical Nutrition Education, Training, and Competencies to Advance Guideline-Based Diet Counseling by Physicians: A Science Advisory From the American Heart Association. Circulation. 2018;137(23):821-841.
9. Willows, N.D. Determinants of healthy eating in Aboriginal peoples in Canada. Can J Public Heal. 2005;96(3):S32-S36.
10. Devries, S., et al. A Deficiency of Nutrition Education and Practice in Cardiology. Am J Med. 2017;130(11):1298-1305.
11. Hu, J., Raman, M., Gramlich, L. Current Status of and Recommendations for Nutrition Education in Gastroenterology Fellowship Training in Canada. Nutr Clin Pract. 2018;33(2):191-197.
12. Vetter, M.L., Herring, S.J., Sood, M., Nirav, R.S., Kalet, A.L. What Do Resident Physicians Know about Nutrition? An Evaluation of Attitudes, Self-Perceived Proficiency and Knowledge. J Am Coll Nutr. 2008;27(2):287-298.
13. Ball, L.E., Johnson, C., Desbrow, B., Leveritt, M.D. General practitioners can offer effective nutrition care to patients with lifestyle- related chronic disease. J Prim Health Care. 2013;5(March 2013):59-69.
14. Deen, D., Spencer, E., Kolasa, K. Nutrition Edu cation in Fam ily Practice Residency Programs. Resid Educ. 2003;35(2):14-20.
15. Hiddink, G.J., Hautvast, J.G., Van Woerkum, C.M., Fieren, C.J., Van 't Hof, M.A. Consumers' expectations about nutrition guidance: The importance of primary care physicians. Am J Clin Nutr. 1997;65(6 Suppl):1974-1979.
16. Wynn, K., Trudeau, J.D., Taunton, K., Gowans, M., Scott, I. Nutrition in primary care Recherche. Can Fam Physician. 2010;56(110):109-116.
17. Kushner, R.F. Barriers obesity primary care 1995. Prev Med. 1995;24:546-552.
18. Allard, J.P., et al. Malnutrition at Hospital Admission — Contributors and Effect on Length of Stay : A Prospective Cohort Study From the Canadian Malnutrition Task Force. 2016. JPEN J Parenter Enteral Nutr. 2016;40(4):487-497.
19. Duerksen, D.R., et al. Physicians' Perceptions Regarding the Detection and Management of Malnutrition in Canadian Hospitals: Results of a Canadian Malnutrition Task Force Survey. J Parenter Enter Nutr. 2015;39(4):410-417.
20. Lim, S.L., et al. Malnutrition and its impact on cost of hospitalization, length of stay, readmission and 3-year mortality. Clin Nutr. 2012;31(3):345-350.
21. Roche, P.L., Ciccarelli, M.R., Gupta, S.K., Hayes, B.M., Molleston, J.P. Multi-School Collaboration to Develop and Test Nutrition Computer Modules for Pediatric Residents. J Am Diet Assoc. 2007;107(9):1586-1589.
22. Gonzalez, J.L., Gilmer, L. Obesity prevention in pediatrics: A pilot pediatric resident curriculum intervention on nutrition and obesity education and counseling. J Natl Med Assoc. 2006;98(9):1483-1488.
23. Gramlich, L.M., et al. Medical students' perceptions of nutrition education in Canadian universities. Appl Physiol Nutr Metab. 2010;35(3):336-343.
24. Hanninen, S., Rashid, M., Frcp, C. Assessment of Students' Perception of the Nutrition Curriculum in a Canadian Undergraduate Medical Education Program. J Can Assoc Gastroenterol. 2019;2(3):141-147.
25. Fenwick, P., Colborne, A., Theou, O., Cahill, L. Medical students' perceptions of nutrition in medical education and future practice. Dalhousie Med J. 2020;47(1):23-30.
26. Raman, M., Violato, C., Coderre, S. How much do gastroenterology fellows know about nutrition? J Clin Gastroenterol. 2009;43(6):559-564.
27. Van Horn, L. The Nutrition Academic Award: brief history, overview, and legacy. Am J Clin Nutr. 2006;83:936-40.
28. Adams, K.M., Lindell, K.C., Kohlmeier, M., Zeisel, S.H. Status of nutrition education in medical schools. Am J Clin Nutr. 2006;83(4)941-944.
29. Adams, K.M., Butsch, W.S., Kohlmeier, M. The State of Nutrition Education at US Medical Schools. J Biomed Educ. 2015;2015:1-7.
30. Smith, S., et al. Primary Care Residents' Knowledge, Attitudes, Self-Efficacy, and Perceived Professional Norms Regarding Obesity, Nutrition, and Physical Activity Counseling. J Grad Med Educ. 2015;7(3):388-394.
31. Temple, N.J. Survey of Nutrition Knowledge of Canadian Physicians. J Am Coll Nutr. 1999;18(1):26-29.
32. Jay, M., et al. Do internists, pediatricians, and psychiatrists feel competent in obesity care?: Using a needs assessment to drive curriculum design. J Gen Intern Med. 2008;23(7):1066-1070.
33. Singh, H., Duerksen, D.R. Survey of clinical nutrition practices of Canadian gastroenterologists. Can J Gastroenterol. 2006;20(8):527-530.
34. Antognoli, E.L., Seeholzer, E.L., Gullett, H., Jackson, B., Smith, S., Flocke, S.A. Primary Care Resident Training for Obesity, Nutrition, and Physical Activity Counseling: A Mixed-Methods Study. Health Promot Pract. 2017;18(5):672-680.
35. Taren, D.L., et al. Effect of an integrated nutrition curriculum on medical education, student clinical performance, and student perception of medical-nutrition training. Am J Clin Nutr. 2001;73(6):1107-1112.
36. Pack, Q.R., Keteyian, S.J., McBride, P.E., Weaver, W.D., Kim, H.E. Current status of preventive cardiology training among united states cardiology fellowships and comparison to training guidelines. Am J Cardiol. 2012;110(1):124-128.

Appendix 1

Frequency of Nutrition Questionnaire Responses (%)

Question					
Nutrition Attitudes					
	Strongly Disagree	**Disagree**	**Neither Agree or Disagree**	**Agree**	**Strongly Agree**
Nutrition counselling can make a positive difference to patient health outcomes.	0 (0.0)	0 (0.0)	4 (9.8)	18 (43.9)	19 (46.3)
Physicians play a key role in improving patients' nutritional habits.	0 (0.0)	1 (2.4)	13 (36.6)	21 (51.2)	4 (9.8)
Nutritional assessment should be a routine part of care by all physicians, regardless of specialty.	1 (2.4)	18 (43.9)	8 (19.5)	11 (26.8)	3 (7.3)
Nutritional counselling should be a part of routine care by all physicians, regardless of specialty.	2 (4.9)	13 (31.7)	9 (22.0)	15 (36.6)	2 (4.9)
Physicians can influence patient behaviour related to nutrition.	0 (0.0)	2 (4.9)	6 (14.6)	25 (61.0)	8 (19.5)
Nutrition Knowledge					
I know basic nutrition concepts. (e.g. types of macro and micronutrients)	0 (0.0)	3 (7.3)	3 (7.3)	25 (61.0)	10 (24.4)
I understand the role of nutrition in the pathophysiology of specific diseases. (e.g. cancer, cardiovascular, respiratory diseases)	0 (0.0)	8 (19.5)	8 (19.5)	20 (48.8)	5 (12.2)
I understand the role of nutrition in the treatment of diseases. (e.g. nutrition recommendations to lower cholesterol levels)	0 (0.0)	7 (17.1)	6 (14.6)	24 (58.5)	4 (9.8)
I know how and where to access credible nutrition information and/or resources. (e.g. Canada's Food Guide, Harvard Nutrition Source, a registered dietitian)	0 (0.0)	5 (12.2)	3 (7.3)	26 (63.4)	7 (17.1)
Perceptions of Nutrition Education					
The amount of time dedicated to nutrition education in my medical education and residency training seems appropriate.	12 (19.3)	13 (31.7)	6 (14.6)	8 (19.5)	2 (4.9)
Nutrition education is/was well integrated into various aspects of my curriculum.	6 (14.6)	18 (43.9)	9 (22.0)	6 (14.6)	2 (4.9)
My medical education and residency training in terms of nutrition has prepared me for my career as a physician.	3 (7.3)	12 (29.3)	15 (36.6)	9 (22.0)	2 (4.9)
I feel that I am able to provide my patients with adequate nutrition counselling.*	2 (5.0)	12 (30.0)	11 (27.5)	14 (35.0)	1 (2.5)

** One participant chose N/A for question 13, making up 2.4% of responses for that question.*

Appendix 2

Mean and Standard Deviation of Questionnaire Responses

N=41 (five-point Likert scale, one = strongly disagree; five = strongly agree)

Question	
Nutrition Attitudes	
	Mean (Std. Deviation)
Nutrition counselling can make a positive difference to patient health outcomes.	4.37 (+/- 0.662)
Physicians play a key role in improving patients' nutritional habits.	3.68 (+/- 0.687)
Nutritional assessment should be a routine part of care by all physicians, regardless of specialty.	2.93 (+/- 1.058)
Nutritional counselling should be a part of routine care by all physicians, regardless of specialty.	3.05 (+/- 1.048)
Physicians can influence patient behaviour related to nutrition.	3.95 (+/- 0.740)
Nutrition Knowledge	
I know basic nutrition concepts. (e.g. types of macro and micronutrients)	4.02 (+/- 0.740)
I understand the role of nutrition in the pathophysiology of specific diseases. (e.g. cancer, cardiovascular, respiratory diseases)	3.54 (+/- 0.951)
I understand the role of nutrition in the treatment of diseases. (e.g. nutrition recommendations to lower cholesterol levels)	3.61 (+/- 0.891)
I know how and where to access credible nutrition information and/or resources. (e.g. Canada's Food Guide, Harvard Nutrition Source, a registered dietitian)	3.85 (+/- 0.853)
Perceptions of Nutrition Education	
The amount of time dedicated to nutrition education in my medical education and residency training seems appropriate.	2.39 (+/- 1.243)
Nutrition education is/was well integrated into various aspects of my curriculum.	2.51 (+/- 1.075)
My medical education and residency training in terms of nutrition has prepared me for my career as a physician.	2.88 (+/- 1.005)
I feel that I am able to provide my patients with adequate nutrition counselling.*	2.93 (+/- 1.081)

Appendix 3

Average means (± Standard Deviation) for questionnaire domains: Attitudes, Knowledge, and Satisfaction

(five-point Likert scale, one = strongly disagree; five = strongly agree)

Questionnaire Domain	Mean (Std.Deviation)
Attitudes	3.60 (+/- 0.633)
Knowledge	3.76 (+/- 0.702)
Satisfaction	2.70 (± 0.898)

Appendix 4

Participant comments

"I am in diagnostics so I do not interact with patients"

"This is easier said than done. Get some practical experience and you will see"

"I feel competent to provide basic counselling but would defer to a dietician when needed. Most physicians would likely be limited in terms of the amount of time they could spend discussing nutrition."

"I don't feel that physicians should be the primary people counselling on nutrition. We have dieticians for this and should use them as adjuncts just like we use physiotherapists or social workers."

"A place to potentially slot more nutritional education in would be professional competencies in the tone of how it would affect low SES patients."

"All specialists do not have time to provide nutritional counselling nor should it be a routine part of a consultation if not relevant. But if a patients nutritional habits directly impact the care provided by a specialist they should be addressed."

"For specialist, nutrition counselling may be challenging because of the length of time between visits (may only see them once a year). Patient adherence is also a challenge. In depth nutrition counselling for patients only really becomes relevant if they can make a good start on the basics first."

"We had next to no nutrition in our curriculum. Anything I know is based on my own learning through various fitness programs as I am a trained fitness instructor"

"I have some serious questions regarding the evidence for the nutritional education I was given during medical school. I am not convinced that a low fat, high carbohydrate diet is healthful or that excess weight is caused by more calories in than out."

"My answer to #13 is based on SELF-STUDY and critical appraisal of literature and my formal medical education CAN NOT take credit for my current abilities in nutritional counselling, as I consider it a special interest of mine on par with obstetrics or palliative care"

"I feel the role of in-depth nutritional counselling is best suited, both in expertise and available time, to the role of a dietician. My role as family doc is to encourage and know high level"

Workers' compensation board claims and emergency department diagnostic management of non-specific low back pain

Julien Courville, BSc[1], Rachel Ogilvie, MA[2], Jill A. Hayden, DC, PhD[2]

1. Department of Medical Sciences, Dalhousie University
2. Department of Community Health and Epidemiology, Dalhousie University

Abstract

Background: Low back pain is a leading cause of disability worldwide and results in enormous healthcare and lost productivity costs. Guidelines exist to guide the management of low back pain, but guideline adherence varies.
Objective: This study assessed whether initial presentation to the emergency department for non-specific low back pain with a Workers' Compensation Board of Nova Scotia claim was associated with different diagnostic management from non-claimants.
Methods: In this retrospective cohort study, we analyzed administrative data from four emergency departments in Nova Scotia on 18,337 adult patients who presented for non-specific low back pain between July 15, 2009 and May 1, 2019. All data were retrieved from the Nova Scotia Health Authority Emergency Department Information System.
Results: Patients had a mean age of 43 years and 51.3% were female. Most patients were assigned a Canadian Triage Acuity Scale score of 3 (51.9%) and reported moderate (51.2%) to severe pain (41.5%). Occupational injuries consisted of 11.6% of visits. More than 37% of patients received one or more diagnostic test. Patients with occupational injuries were less likely to receive diagnostic tests (odds ratio [OR] = 0.52, 95% CI 0.47 to 0.58), imaging (OR = 0.60, 95% CI 0.54 to 0.67), and laboratory tests (OR = 0.35, 95% CI 0.29 to 0.43). These results remained consistent when controlling for covariates.
Conclusion: Patients who presented to the emergency department for occupational non-specific low back pain were less likely to receive diagnostic tests compared to non-occupational non-specific low back pain patients.

Background

Low back pain is a leading cause of disability worldwide[1,2], affecting 49-90% of people during their lifetime3–7. While low back pain can resolve within a few weeks[6,8], it tends to follow a fairly persistent and painful course[9–11]. There are extensive costs associated with the condition, including both direct (i.e. healthcare costs) and indirect costs (i.e. lost productivity, disability payments)[12,13].

Low back pain is a common cause for presentation to the emergency department (ED). In 2018, back pain was the fourth most common presenting complaint in Canadian EDs for individuals of the typical working population, between ages 19 and 64[14]. Over 85% of cases are non-specific, meaning that the pain cannot be attributed to a pathoanatomical cause[5,8,13,15]. Low back pain is rarely attributed to serious pathologies, such as cancer or infection[13]. Thus, clinical practice guidelines state that diagnostic tests, such as diagnostic imaging and laboratory tests (i.e. bloodwork and urinalysis) should not be used in the absence of red flags[5,15–18]. Further, diagnostic tests have been associated with poorer outcomes, such as prolonged disability and inflated medical expenditure, and with unnecessary and harmful procedures[5,19–21]. Despite the availability of guidelines, studies have found that diagnostic tests are still used frequently in the management of low back pain[22–26].

Musculoskeletal injuries, like low back pain, commonly occur within compensation systems for workplace incidents[27]. According to the Workers' Compensation Board of Nova Scotia (WCB-NS), the back was the most commonly cited 'part of body' injury in 2018, representing 25.8% of recorded injuries[28]. Numerous studies have found compensation to be associated with poorer outcomes following musculoskeletal injuries. For example, a Japanese study found that the odds of developing chronic low back pain were significantly higher among people who had received compensation for a previous bout of low back pain compared to patients who had not been compensated[4]. However, some of the systematic reviews that support this association are based on primary studies with significant methodological flaws, according to Spearing & Connelly[29].

Although, one study found that workers with musculoskeletal pain who receive large amounts of income replacement (>100%) claim benefits for longer than those receiving income replacement of equal or lesser value than their income[30]. These results appear to reinforce the association between compensation and poorer outcomes if the resolution of low back pain is defined as time until return to work.

The association between compensation and outcomes may arise from differential management or leniency with occupational and non-occupational patients. One study found that general practitioners were more accommodating with their workers' compensation patients in prescribing time off work[31]. They also found that 24% of workers with acute low back pain had firm beliefs about how their pain should be managed, which often were not in accordance with evidence-based care[31]. Further, physicians' beliefs have been associated with the management of low back pain due to reasons such as potential legal action if imaging is not ordered for patients[32]. Such factors could potentially influence physicians to order more diagnostic tests for patients if their injuries will be investigated by the WCB-NS.

We are not aware of any research that has compared the frequency of use of diagnostic tests in the ED between occupational and non-occupational non-specific low back pain. The purpose of this study was to fill this gap and assess whether initial presentation to the ED for non-specific low back pain with a WCB-NS claim was associated with different diagnostic management from non-claimants.

Methods

Design and data source

This retrospective cohort study analyzed administrative data collected from the Nova Scotia Health Authority Central Zone Emergency Department Information System (EDIS) between July 15, 2009 and May 1, 2019. All patients who presented to the ED during this time were captured in the database. This study received ethical approval from the Nova Scotia Health Authority Research Ethics Board (ROMEO # 1024608).

Study population

Our study population was identified from EDIS data from four EDs in the Nova Scotia Health Authority Central Zone: QEII Health Sciences Centre, Dartmouth General Hospital, Hants Community Hospital, and Cobequid Community Health Centre. We defined our eligible population as adults who presented for the first time to these EDs with a chief complaint of "Back Pain" or "Traumatic Back/Spine Injury" and who left with an ICD-9 code consistent with non-specific or mechanical low back pain. We included patients

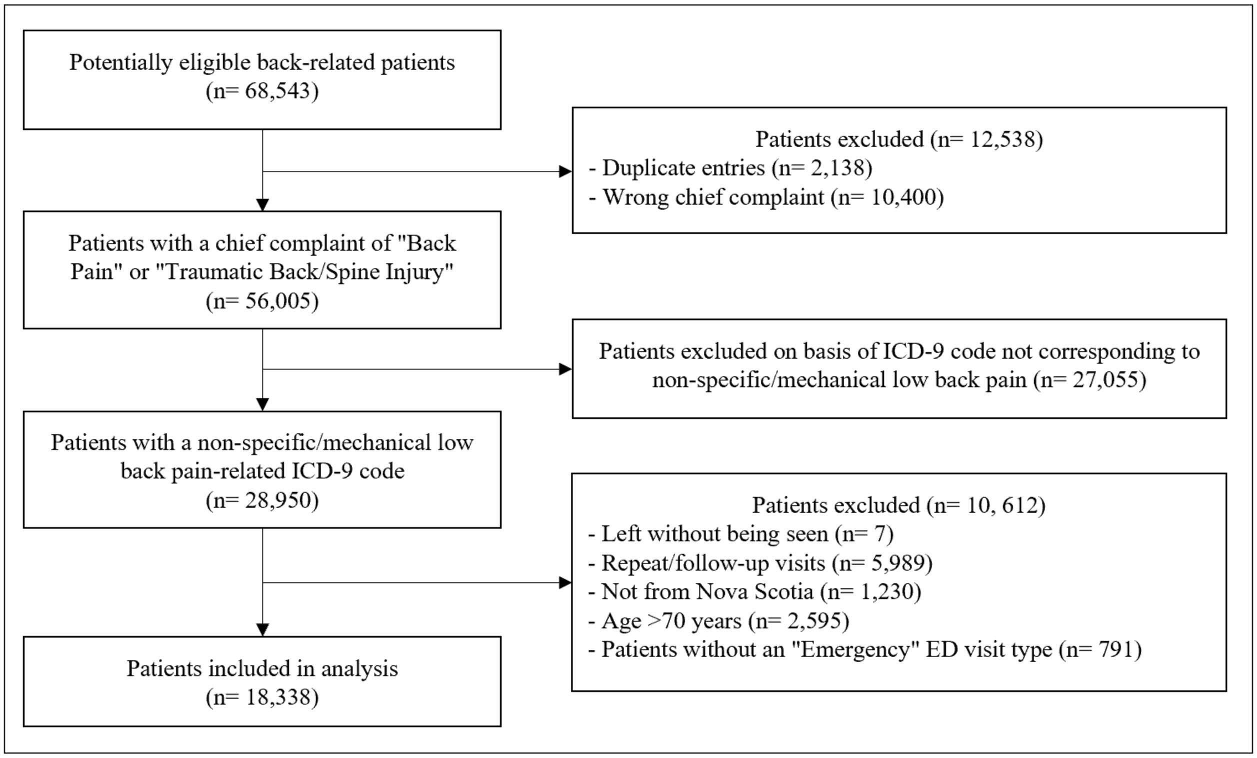

Figure 1. Flow diagram of the study population.

who presented independently or through Emergency Health Services (i.e. helicopter or ambulance). We excluded patients who were not residents of Nova Scotia. Finally, we made a post hoc decision to set the upper age limit of patients to 70 years, inclusive, in order to represent a majority working population and to limit potential confounding, as very few older patients (70+) had presented with an occupational injury.

Exposure, covariates, and outcomes

Our exposure status consisted of being a WCB-NS claimant, as opposed to a non-claimant. EDIS recorded the responsibility for payment of the patients' ED visits, allowing us to determine whether patients were WCB-NS claimants or not. Under the "responsibility for payment" column, patients who were categorized as "WCB Nova Scotia," "Department of Health," "Dept of Health," and "Self – NS Resident," were considered to be residents of Nova Scotia. The former category was used to categorize WCB-NS claimants while the latter three were used to categorize non-claimants.

While we described our exposure as being a WCB-NS claimant, we also identified a number of covariates including age, sex, Canadian Triage Acuity Scale (CTAS) score, method of arrival, whether the patient had a primary care provider at the time of presentation, and the site of presentation. These covariates were controlled for in our analysis.

The primary outcome measures in this study were the categorical variables for diagnostic tests (i.e. none or any one or more of: x-ray, CT, MRI, urinalysis, and bloodwork), diagnostic imaging (i.e. none or any one or more of: x-ray, CT, and MRI), and laboratory tests (i.e. none or any one or both of: urinalysis and bloodwork).

Statistical analysis

All data were imported into and analyzed with Stata statistical software[33]. Descriptive analyses consisted of describing categorical variables as frequencies (%) and continuous variables as a mean with a standard deviation since the data were distributed normally. Multivariable logistic regression analyses were performed to assess the association between the exposure and outcome measures. Odds ratios (OR) and adjusted ORs were calculated for the associations of interest and presented with corresponding 95% confidence intervals.

Results

Study population selection

Sociodemographic and ED visit characteristics (Table 1) were retrieved from EDIS for 66,543 potentially eligible patients who presented to the ED. Patients were then excluded if they were duplicate entries or if they presented with a chief complaint other than "Back Pain" or "Traumatic Back/Spine Injury," were assigned an ICD-9 code that did not represent non-specific or mechanical low back pain, left without being seen, presented for a repeat/follow-up visit, were not Nova Scotian, were over 70 years old, and if they did not present as an "Emergency" to the ED (Figure 1). This resulted in the inclusion of 18,338 patients in our analysis.

Characteristics of the study population

Characteristics of the 18,338 included patients were analyzed and aggregated (Table 2). Patients had a mean age of 43 years and 51.3% were female. Upon arrival, the majority of patients were assigned a CTAS score of 3 (urgent) and about one third were assigned a score of 4 (less urgent). Most patients reported experiencing moderate (52.2%) or severe pain (41.5%), while fewer reported mild pain (7.3%). The WCB-NS was responsible for the payment of 11.6% of visits and the rest (88.4%) were paid for by the individual or by the Department of Health of Nova Scotia. Almost all patients reported having a primary care provider at the time of presentation. 90.9% of patients presented to the ED independently, while 9.1% arrived via Emergency Health Services. The most common sites of presentation were the QEII Health Sciences Centre (34.5%), Cobequid Community Health Centre (29.4%), and Dartmouth General Hospital (26.0%). On average, patients stayed in the ED for 3.4 hours and few patients (0.4%) were admitted to hospital.

Frequency of diagnostic tests

Upon presentation to the ED, 37.2% of patients received a diagnostic test (Table 3). More than 30% of patients received an imaging study, most of whom received an x-ray (27.5%). Over 12% of patients received a laboratory test. While 25% of WCB-NS claimants received a diagnostic test, roughly 39% of non-claimants received a test. For imaging, roughly 22% of claimants received a study, while over 31% of non-claimants received one. Meanwhile, the frequency of laboratory tests ordered for claimants (5.1%) was less than half that for non-claimants (13.2%).

Compared to non-claimant patients, claimants were less likely to receive a diagnostic test (OR = 0.52, 95% CI 0.47 to 0.58), an imaging study (OR = 0.60, 95% CI 0.54 to 0.67), and a laboratory test (OR = 0.35, 95% CI 0.29 to 0.43). When controlling for covariates, similar associations were found: claimants were less likely to receive a diagnostic test (adjusted OR = 0.57, 95% CI 0.51 to 0.63), an imaging study (adjusted OR = 0.66,

Table 1. EDIS variables collected and respective descriptions.

Concept	Description
Age	Presented in years
Sex	• Male • Female
Has/does not have a primary care provider?	• Yes • No
Responsibility for payment	Various categories, including but not limited to: • Department of Health of Nova Scotia • Self - NS Resident • WCB-NS • Other provinces • Private insurance
Type of ED visit	Various categories, including but not limited to: • Emergency • Return visit • Referral from GP/clinic • 811 referral
Method of arrival	• Independent • EHS (ambulance or helicopter)
Time of presentation	Presented as a date
Chief complaint	• Back pain • Traumatic back/spine injury
CTAS score	Number between 1-5: • 1 = Resuscitation • 2 = Emergent • 3 = Urgent • 4 = Less Urgent • 5 = Non-Urgent
Pain Score	Number between 0-10, signifying level of pain: • Mild (0-3) • Moderate (4-7) • Severe (8-10)
ICD-9 code	Various ICD-9 codes consistent with non-specific low back pain
Discharge diagnosis	Various categories, including but not limited to: • Back pain • Chronic back pain • Muscle spasm back
Site of presentation	One of the following: • QEII Health Sciences Centre • Dartmouth General Hospital • Cobequid Community Health Centre • Hants Community Hospital
Diagnostic test information	Information on whether the following tests were ordered: • X-ray • CT • MRI • Routine bloodwork • Urinalysis
Length of stay	Presented in hours
Admission to hospital	• Yes • No

Table 2. Patient and visit characteristics for Nova Scotian non-specific low back pain patients presenting to Nova Scotia Health Authority Central Zone EDs (n = 18,338)

Characteristic	Number (%)*
Age (Mean, SD)	43 years (14)
Female sex	9,399 (51.3)
Primary Care Provider	16,543 (90.2)
Method of arrival (n= 18,338)	
• Independent	16,675 (90.9)
• Emergency Health Services	1,663 (9.1)
CTAS (1-5)	
• 1	0 (0.0)
• 2	2,254 (12.3)
• 3	9,515 (51.9)
• 4	6,350 (34.6)
• 5	219 (1.2)
Pain score (0-10) (n= 11,841; 6,497 missing)	
• Mild (0-3)	863 (7.3)
• Moderate (4-7)	6,061 (51.2)
• Severe (8-10)	4,917 (41.5)
ED of presentation	
• QEII Health Sciences Centre	6,324 (34.5)
• Dartmouth General Hospital	4,771 (26.0)
• Cobequid Community Health Centre	5,399 (29.4)
• Hants Community Hospital	1,844 (10.1)
Length of stay (Mean, SD)	3.4 hours (2.8)
Hospital admission	79 (0.4)
Responsibility for payment	
• Department of Health, NS or Self	16,219 (88.4)
• Workers' Compensation Board of Nova Scotia	2,119 (11.6)

** Unless noted otherwise.*

95% CI 0.59 to 0.74), and a laboratory test (adjusted OR = 0.38, 95% CI 0.31 to 0.47) than non-claimants.

Discussion

Our study population was similar to that of US EDs between 2002 and 2006, according to a secondary data analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS). For example, the NHAMCS recorded statistics similar to those in this study for average age of patients (40 years), proportion of patients who were female (51.2%), and proportion of patients who presented independently to the ED (91.3%)23. However, a greater proportion of patients presented with severe pain (54.2%) than moderate pain (30.6%) in the US23, while more patients presented with moderate pain than severe pain in our study. Additionally, 7.5% of patients were workers' compensation cases in the US, while we recorded 11.6% as such.

We found that the odds of receiving a diagnostic test or imaging was lower in claimants presenting to the ED with non-specific low back pain compared to

Table 3. Frequency of diagnostic tests performed for non-specific low back pain patients in Nova Scotia Health Authority Central Zone EDs (n = 18,338)*

Diagnostic test	Total	WCB-NS	Non WCB-NS
	Number (%)		
Any diagnostic test	6,815 (37.2)	526 (24.8)	6,219 (38.8)
Any imaging	5,539 (30.2)	456 (21.5)	2,083(31.3)
X-ray	5,044 (27.5)		
CT	779 (4.3)		
MRI	8 (0.04)		
Any laboratory test	2,242 (12.2)	107 (5.1)	2,135 (13.2)
Urinalysis	971 (5.3)		
Bloodwork	2,240 (12.2)		

* *Frequency of certain diagnostic tests are missing as we were not able to access the data due to COVID-19 closures.*

non-claimants when adjusted for covariates (including age, sex and CTAS score). While the direction of this relationship was not expected, the rates of imaging we found were similar to the rates of imaging reported in other studies (27.2%-30.5% for x-rays; 29%-37% for any imaging)23–26,34. Meanwhile, the rate of urinalysis was lower among our study population in comparison to other studies (18.8%-21.9%)23,34. As we believe that this is the first study to compare the diagnostic management of non-specific low back pain in the ED between occupational and non-occupational cases, we cannot compare our rates to previously reported ones.

Our results may have differed from our hypothesis due to a variety of reasons. For example, there is a level of oversight associated with WCB-NS claims. It is possible that ED physicians feel more empowered to adhere strictly to guideline recommended care given that all patients will be followed by the WCB-NS, providing opportunity for diagnostic investigations at a later date, if necessary. Additionally, occupational cases may be linked to a specific or known injury more frequently than non-occupational cases, making diagnostic testing unnecessary in most cases.

Strengths and Limitations

Using EDIS enabled us to ascertain detailed descriptions of patients' characteristics retrospectively at minimal cost. Further, variables were well recorded with only a relatively small number of missing observations. This study also included all patients who met the inclusion criteria rather than a sample, reducing potential selection bias and increasing generalizability of the results. Misclassification bias was also likely low in this study as diagnostic tests would have had to be classified properly in the database for the test(s) to be ordered. While it is possible that patients filed WCB-NS claims that later turned out to be unsuccessful, they would have been managed as a claim by ED physicians, nonetheless.

Eliminating patients from the study population based on age, residency status, repeat/follow-up visits, and visit type, was our way to reduce potential confounding by only including working age Nova Scotians initially presenting to the ED for emergent non-specific low back pain. Eliminating patients over the age of 70 may have weakened our results as older patients were less likely to be claimants and may have been more likely to receive diagnostic testing due to comorbidities. In addition, it is possible that not all workers were eligible to file a claim with the WCB-NS and so did not report being a claimant. We believe that the measures taken to ensure minimal confounding and bias were adequate to determine robust associations.

Despite the fact that the rates of diagnostic testing among non-claimants were significantly higher than the rates among claimants, we cannot determine whether there was overuse of diagnostic tests. We did not collect patient information beyond what was available on EDIS; therefore, we were unable to ascertain the presence of red flags, comorbidities, or mechanism of injury in either category to determine the appropriateness of imaging studies. The nature of administrative data also limited our interpretations as we could not collect patients' education status, ethnicity/background, history, physical examination results, or treatment(s) received. These factors could have potentially influenced the results of the study.

Patient sociodemographic characteristics, injury characteristics, and occupational injury incidence may also differ around the country and thus may hinder generalizability. Additionally, provincial differences in healthcare availability and structure may also act as barriers to national generalizability.

Future Research

Future research should aim to understand why fewer diagnostic tests were ordered for claimants than non-claimants on initial presentation to the ED and investigate repeat visits in both groups. Other research should also attempt to replicate our study in different geographical settings and healthcare systems, as well as compare management between academic, tertiary, and community care centres. Further, as most patients seeking care for non-specific low back pain present to primary care centres[6], future studies should examine the role of WCB-NS claimant status on diagnostic tests ordered by primary care physicians.

Conclusion

We found that diagnostic tests were used less frequently in the ED management of occupational non-specific low back pain in comparison to non-occupational cases. While clinical practice guidelines are available to guide physicians in the management of non-specific low back pain, there appears to be a discrepancy of adherence to them when treating occupational and non-occupational injuries. The results elucidate an association between WCB-NS claimant status and diagnostic management that warrants further study.

References

1. Hoy, D.G., March, L.M., More, A. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. Ann Rheum Dis 2014;31(1):5-8.
2. Vos, T., et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380(9859):2163-2196.
3. Bell, J.A., Burnett, A. Exercise for the primary, secondary and tertiary prevention of low back pain in the workplace: A systematic review. J Occup Rehabil 2009;19(1):8-24.
4. Fujii, T., Matsudaira, K., Oka, H. The association between compensation and chronic disabling back pain. J Orthop Sci 2012;17(6):694-698.
5. Jarvik, J.G., Deyo, R.A. Diagnostic Evaluation of Low Back Pain with Emphasis on Imaging. Ann Intern Med 2002;137(7):586-597.
6. Scott, N.A., Moga, C., Harstall, C. Managing low back pain in the primary care setting: The know-do gap. Pain Res Manag 2010;15(6):392-400.
7. Woolf, A.D., Pfleger, B. Burden of major musculoskeletal conditions. Bull World Health Organ 2003;81(9):646-656.
8. Chou, R., et al. Diagnosis and treatment of low back pain: A joint clinical practice guideline from the American College of Physicians and the American Pain Society. Ann Intern Med 2007;147(7):478-491.
9. Hestbaek, L., Leboeuf-Yde, C., Manniche, C. Low back pain: what is the long-term course? A review of studies of general patient populations. Eur Spine J 2003;12(2):149-165.
10. Menezes Costa, L.D.C., et al. Prognosis for patients with chronic low back pain: Inception cohort study. BMJ 2009;339;b3829.
11. Carey, T.S., Garrett, J.M., Jackman, A.M. Beyond the good prognosis: Examination of an inception cohort of patients with chronic low back pain. Spine 2000;25(1):115-120.
12. French, S.D., et al. Imaging use for low back pain by Ontario primary care clinicians: Protocol for a mixed methods study - The Back on study. BMC Musculoskelet Disord 2019;20(1):1-10.
13. Maher, C., Underwood, M., Buchbinder, R. Non-specific low back pain. Lancet 2016;389(10070):736-747.
14. CIHI. NACRS Emergency Department Visits and Length of Stay, 2017–2018 [Internet]. 2018 [cited 2019 Nov 05]. Available from: https://www.cihi.ca/en/nacrs-emergency-department-visits-and-length-of-stay-2017-2018
15. Deyo, R.A., Weinstein, J.N. Low Back Pain. N Engl J Med 2001;344(5):363-370.
16. Oliveira, C.B., et al. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. Eur Spine J 2018;27(11):2791-2803.
17. Foster, N.E., et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet 2018;391(10137):2368-2383.
18. Downie, A., et al. How common is imaging for low back pain in primary and emergency care? Systematic review and meta-analysis of over 4 million imaging requests across 21 years. Br J Sports Med 2020;54(11):642-651.
19. Webster, B.S., Cifuentes, M. Relationship of early magnetic resonance imaging for work-related acute low back pain with disability and medical utilization outcomes. J Occup Environ Med 2010;52(9):900-907.
20. Lurie, J.D., Birkmeyer, N.J., Weinstein, J.N. Rates of advanced spinal imaging and spine surgery. Spine 2003;28(6):616-620.
21. Webster, B.S., Bauer, A.Z., Choi, Y., Cifuentes, M., Pransky, G.S. Iatrogenic consequences of early magnetic resonance imaging in acute, work-related, disabling low back pain. Spine 2013;38(22):1939-1946.
22. Edwards, J., Hayden, J., Asbridge, M., Magee, K. The prevalence of low back pain in the emergency department: A descriptive study set in the Charles V. Keating Emergency and Trauma Centre, Halifax, Nova Scotia, Canada. BMC Musculoskelet Disord 2018;19(1):1-10.
23. Friedman, B.W., Chilstrom, M., Bijur, P.E., Gallagher, E.J. Diagnostic Testing and Treatment of Low Back Pain in United States Emergency Departments A National Perspective. Spine 2010;35(24):E1406-E1411.
24. Schlemmer, E., Mitchiner, J.C., Brown, M., Wasilevich, E. Imaging during low back pain ED visits: A claims-based descriptive analysis. Am J Emerg Med 2015;33(3):414-418.
25. Tan, A., Zhou, J., Kuo, Y.F., Goodwin, J.S. Variation among Primary Care Physicians in the Use of Imaging for Older Patients with Acute Low Back Pain. J Gen Intern Med 2016;31(2):156-163.
26. Kamper, S.J., et al. What is usual care for low back pain? A systematic review of health care provided to patients with low back pain in family practice and emergency departments. Pain 2019;00(00):1-9.
27. Murgatroyd, D.F., Casey, P.P., Cameron, I.D., Harris, I.A. The Effect of Financial Compensation on Health Outcomes following Musculoskeletal Injury : Systematic Review. PLoS One 2015;10(2):1-33.
28. WCB Nova Scotia. WCB Nova Scotia Annual Report 2018 [Internet]. 2018 [cited 2019 Nov 05];11. Available from: https://www.annualreport.wcb.ns.ca/
29. Spearing, N.M., Connelly, L.B. Is compensation "bad for health"? A systematic meta-review. Injury 2011;42(1):15-24.
30. Souza, N.S.S., Santana, V.S. Factors associated with dura-

tion of disability benefits: A cohort study. Rev Saude Publica 2012;46(3):425-434.

31. McGuirk, B., Bogduk, N. Evidence-based care for low back pain in workers eligible for compensation. Occup Med (Chic Ill) 2007;57(1):36-42.
32. Hall, A.M., et al. Physician-reported barriers to using evidence-based recommendations for low back pain in clinical practice: A systematic review and synthesis of qualitative studies using the Theoretical Domains Framework. Implement Sci 2019;14(1):1-19.
33. StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP.
34. Nunn, M.L., Hayden, J.A., Magee, K. Current management practices for patients presenting with low back pain to a large emergency department in Canada. BMC Musculoskelet Disord 2017;18(1):1-8.

DALHOUSIE MEDICAL ALUMNI ASSOCIATION
SUPPORTING FACULTY OF MEDICINE STUDENTS SINCE 1958

The DMAA strengthens your student experience through a range of supports and services, including student awards and bursaries, mentorship, and student interest projects.

We also support:

- Student Activities
- VoxMeDal Magazine
- Micro-Mentorship Programming
- Resident Wellness
- Alumni Awards
- Convocation
- Class Reunions

Once you graduate, we become your link to Dalhousie Medical School. Through the DMAA you will learn about international recognition and research advances at Dalhousie Medical School, discover personal and professional achievements of your fellow alumni, and reconnect with your former classmates through Alumni Days and reunion celebrations.

medical.alumni@dal.ca

DALHOUSIE
UNIVERSITY
FACULTY OF MEDICINE

ORIGINAL RESEARCH

The effect of funding non-invasive prenatal testing (NIPT) on invasive procedures performed to identify trisomy 21 pregnancies: A population-based cohort study

Marianne Levesque, MD[1], Victoria M. Allen, MD, MSc[1], Christy G. Woolcott, PhD[1,2], Jo-Ann K. Brock, MD, PhD[3]

1. Department of Obstetrics & Gynaecology, Dalhousie University
2. Departments of Pediatrics, Dalhousie University
3. Department of Pathology and Laboratory Medicine, Dalhousie University

Abstract

Background: Screening for Trisomy 21 in Nova Scotia has traditionally included serum integrated prenatal screening (SIPS, maternal serum screening), and integrated prenatal screening (maternal serum screening with nuchal translucency, IPS) for those patients considered to be at high risk. In 2016, non-invasive prenatal testing (NIPT) became available as a funded second tier screen for pregnancies at high risk for Trisomy 21 in Nova Scotia.
Objective: To compare pregnancy characteristics and number of diagnostic procedures performed for high risk of Trisomy 21 before and after introduction of funded NIPT in Nova Scotia.
Methods: This population-based retrospective cohort study evaluated pregnancies with diagnostic testing and/or NIPT which were identified through the IWK Health Clinical Genomics Laboratory Database. Maternal chart review was performed for each pregnancy to confirm eligibility and collect demographic data. Descriptive statistics comparing number of diagnostic procedures and pregnancy characteristics were performed among two epochs – pre-NIPT (2012-2015) and post-NIPT (2016-2019) using Fisher's exact test, and rates of Trisomy 21 confirmed by diagnostic testing between the two epochs were described.
Results: The population incidence of Trisomy 21 remained stable and maternal demographics were similar between the two epochs; after the introduction of funded NIPT, the number of diagnostic procedures decreased, and when diagnostic testing was performed, the procedures were 6-fold more likely to confirm Trisomy 21 (95% CI 2.6-12.9) following high risk screening.
Conclusion: The decrease in diagnostic procedures with an increase in the prenatal detection of Trisomy 21 demonstrated in this study illustrates the value of NIPT in a population with limited resources for first trimester screening.

Introduction

Trisomy 21 is the most common chromosomal anomaly in newborns, with an incidence of approximately 1 in 750 Canadian live births[1]. In Canada, provincial options for Trisomy 21 screening are influenced by geographic limitations and available resources[2-4]. The Department of Health and Wellness in the province of Nova Scotia funds serum integrated prenatal screening (SIPS, integrating first and second trimester maternal serum screening, without inhibin A) for all women, or integrated prenatal screening (IPS), which includes nuchal translucency assessment in addition to the SIPS, for those considered to be at higher risk based on maternal age and other risk factors. SIPS and IPS are standard provincial aneuploidy screening. Tertiary level ultrasound for assessment of nuchal translucency is offered to individuals estimated to be at high risk of Trisomy 21 based on first trimester maternal serum screening alone (risk for Trisomy 21 ≥ 1:50), or assessment of soft markers[5] is offered to individuals estimated to be at high risk for Trisomy 21 based on either SIPS or IPS (risk for Trisomy 21 ≥ 1:304).

Prior to 2016 in Nova Scotia, invasive diagnostic testing via amniocentesis or chorionic villus sampling (CVS) would be offered to individuals at high risk for Trisomy 21 based on this first tier of standard aneuploidy screening (associated with an additional pregnancy loss rate likely < 0.5%)[6]. Since 2016, non-invasive prenatal testing (NIPT) has been funded as a second tier screen (offered with a high risk first tier screening result) as a next information step[2] to facilitate personal,

Table 1. Characteristics and outcomes in women undergoing prenatal diagnostic testing or funded NIPT for Trisomy 21, by epoch, Nova Scotia, Canada.

Characteristic	2012-2015 n (%)	2016-2019 n (%)	p value
Number having diagnostic testing or funded NIPT	184 (100)	538 (100)	
Maternal age ≥ 35 years	80 (43.5)	259 (48.1)	0.31
Nulliparity	73 (39.7)	186 (34.6)	0.12
Gestational age at testing*, weeks			
≤13+6	6 (3.3)	102 (19.0)	< 0.01
14+0 – 15+6	14 (7.6)	29 (5.4)	0.25
16+0 – 19+6	66 (35.9)	122 (22.7)	< 0.01
≥20	98 (53.3)	285 (53.0)	1.00
Type of test* for high risk result for T21			
CVS	6 (3.3)	9 (1.7)	0.31
Amniocentesis	178 (96.7)	58 (10.8)	< 0.01
NIPT	0 (0.0)	471 (87.6)	-
Prenatally diagnosed pregnancies with T21	8/184 (4.3)	18/67 (26.9)	0.01

**Test = prenatal diagnostic testing or funded NIPT*
NIPT, non-invasive prenatal testing; T21, trisomy 21; CVS, chorionic villous sampling

informed choice6. NIPT technology uses cell-free DNA in maternal plasma to improve performance over traditional screening modalities for Trisomy 213,7. Due to the high negative predictive value of NIPT (>99%)[8], a low-risk result allows women the option to avoid diagnostic procedures and decreases maternal anxiety[9,10].

A retrospective population-based database study was undertaken to describe temporal changes in prenatal and postnatal diagnoses of Trisomy 21 before and after the introduction of funded NIPT as a second tier screen.

Methods

This population-based retrospective cohort study used data derived from the IWK Health Clinical Genomics Laboratory Database (CGLD), combined with maternal health records review, from January 1, 2012 to December 31, 2019. The CGLD database is population-based and contains secure cytogenetic and molecular genetic testing information (such as indication for testing, sample types, and test results) housed within the IWK Clinical Genomics Laboratory, and provides service for all provincially funded tests for the three Maritime Provinces, including Nova Scotia. The CGLD was used to identify all pregnancies for which diagnostic testing and/or NIPT were performed for a high risk standard aneuploidy screening result for Trisomy 21. Pregnancies with prenatal diagnoses of structural anomalies were excluded since NIPT is not offered as a funded test for these patients. Pregnancies for which diagnostic testing was performed for any other indication (including Trisomy 13 or Trisomy 18) were also excluded. The total number of prenatal and postnatal diagnoses of Trisomy 21 was extracted from this database.

For each pregnancy in which either NIPT or a prenatal diagnostic test was done for the indication of high risk for Trisomy 21, maternal health records reviews were performed to obtain data on maternal age, parity, pregnancy plurality, history of previous pregnancy affected by Trisomy 21, gestational age at the time of testing, and testing results.

A descriptive analysis of the study population was undertaken, reporting the number of tests and cases of Trisomy 21. Rates were grouped in two epochs, 2012-2015 and 2016-2019, which represented timeframes before and after the introduction of funded NIPT as a second tier screening method in Nova Scotia. Comparisons of demographic characteristics between epochs were made using Fisher's exact test, and rates of Trisomy 21 confirmed by diagnostic testing between the two epochs were described. Analyses were performed by IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA). Aggregate cell sizes of 1-4 were suppressed to protect patient privacy, in compliance with local data management principles.

Results

As shown in Table 1, among pregnancies without identified structural anomalies predicted to be at high risk for Trisomy 21 with standard aneuploidy screening modalities, 184 individuals undertook invasive diagnostic testing in 2012-2015 (pre-NIPT epoch), whereas 538 individuals undertook second tier screening with either NIPT and/or invasive diagnostic testing in 2016-2019 (post-NIPT epoch). Maternal age, parity, and history of previous Trisomy 21 did not differ among those tested between the two epochs (p>.05). The proportion of twin pregnancies was higher in 2016-2019 compared to

2012-2015 (p=.03). In addition, the proportion of NIPT and/or invasive diagnostic testing done in the first trimester (≤13+6 weeks) was higher (19.0%) in 2016-2019 compared to 3.3% in 2012-2015 (p < .001). Additionally, the proportion of diagnostic tests performed in the first trimester was higher (11.1%) in 2016-2019 compared to 3.3% in 2012-2015 (p = .03).

The number of invasive tests performed decreased from 184 in 2012-2015 to 67 in 2016-2019. Of these women, 4.3% (8/184) in 2012-2015 and 26.9% (18/67) in 2016-2019 were positive for Trisomy 21, meaning that the positive predictive value for the screening algorithm after 2015 was 6.2 times higher (95% CI: 2.9, 13.7).

Prior to funded NIPT, 27 total cases of Trisomy 21 were identified, of which eight (29.6%) confirmed diagnoses were made prenatally and 19 (70.4%) were made postnatally or among cases of intrauterine fetal demise. Cases detected postnatally in 2012-2015 included those because of declined or failed screening, or because patients chose expectant management after a high risk standard screening result. After the initiation of funded NIPT, in which 28 cases of Trisomy 21 were identified, 18 (64.3%) were detected prenatally, and ten (35.7%) postnatally because standard screening by IPS/SIPS was declined or failed. Thus, the proportion of cases detected prenatally was 2.2 times higher (95% CI: 1.1, 4.1) in 2016-2019 compared to 2012-2015.

For reference, the total Trisomy 21 diagnoses in the population (including prenatal, postnatal and intrauterine fetal demise cases in both fetuses affected and unaffected by anomalies) from 2012-2015 was 88, while from 2016-2019 the total was 73; the total number births and pregnancy losses is not available in the CGLD for these timeframes, and therefore the incidence of Trisomy 21 in the population could not be calculated.

Discussion

This population-based cohort study in Nova Scotia described the pattern of diagnosis of Trisomy 21 four years before and four years after the introduction of publicly funded NIPT as a second tier screen for pregnancies determined to be at high risk for Trisomy 21 following local standard aneuploidy screening. The proportion of cases that were detected prenatally more than doubled, while the number of diagnostic procedures performed decreased by 64%. After implementation of funded NIPT, differences were noted in gestational age at testing, with an increase in testing at less than 14 weeks.

Prior to the introduction of funded NIPT in Nova Scotia, options for women screening positive for Trisomy 21 using standard aneuploidy screening included expectant management, self-funded NIPT, or diagnostic testing. For high risk women identified in the first trimester, the high sensitivity of NIPT for Trisomy 21 (99.3%) compared to traditional screening (83% for IPS) allows earlier diagnostic testing; the specificity of NIPT (99.8%) compared to traditional screening (97.9% for IPS) provides earlier reassurance compared to traditional screening[2,3]. The current study demonstrated that NIPT improved access to care, evidenced by both an overall reduction in diagnostic tests for pregnancies not affected by Trisomy 21 and a relative shift in gestational age for second tier investigation via diagnostic testing or funded NIPT, or diagnostic testing alone, from early second trimester (16+0 to 19+6 weeks) to the first trimester for pregnancies affected with Trisomy 21. Improving access to early diagnosis of fetal Trisomy 21 facilitates personal, informed choice, including continuation of pregnancy[6]. Similar results have been observed in two previous studies using data from Quebec, Calgary, Vancouver and Ontario[11,12]. In addition, rates of prenatal diagnosis were improved following the introduction of funded NIPT, suggesting that women who previously may have declined prenatal diagnostic testing would undertake funded NIPT as a second tier screen since it does not pose additional risk of pregnancy loss. Pregnancies complicated by fetal Trisomy 21 in this population and others have been shown to be at increased risk for adverse perinatal outcomes, including fetal demise[13]. Therefore, knowing (positive diagnostic test) or suspecting (high risk NIPT) fetal Trisomy 21 prompts the initiation of increased fetal surveillance and early delivery planning.

This study was able to examine provincial data from pregnancies at high risk for Trisomy 21 based on screening information before and after the introduction of funded NIPT, in order to evaluate selection of NIPT and diagnostic testing options for the indication of high risk for Trisomy 21. The current study was not able to identify women who were offered and declined diagnostic testing from 2012 to 2015, or women who were offered and declined funded NIPT or diagnostic testing from 2016 to 2019, since the number of all high risk screen results was not available in the CGLD. Selecting a population of all women with high risk standard screening for Trisomy 21, instead of a population of women with second tier screening results, may have provided additional information on personal, informed choice, but would have been impracticable since the screening and testing provincial database systems are separated at the present time. Cost-effectiveness studies suggest that contingent NIPT may be more cost effective than undergoing diagnostic testing[14-16], although this evaluation was beyond the scope of our study.

The results of this population-based cohort study provide an example of how NIPT may be used to improve care in a population with limited resources for first trimester aneuploidy screening, since nuchal translucency risk adjustment (SIPS) is only available in Nova Scotia for populations identified as high risk for maternal or fetal disorders. NIPT provides information earlier in pregnancy and reduces the number of invasive diagnostic tests that are associated with an increased risk of pregnancy loss.

References

1. Public Health Agency of Canada. “Down syndrome surveillance in Canada, 2005-2013”. Ottawa, 2017. <https://www.canada.ca/en/public-health/services/publications/healthy-living/down-syndrome-surveillance-2005-2013.html> (Accessed August 24, 2021)
2. Audibert, F., et al. No. 348. Joint SOGC-CCMG Guideline: Update on prenatal screening for fetal aneuploidy, fetal anomalies, and adverse pregnancy outcomes. J Obstet Gynaecol Can 2017;39:805-17.
3. Chitayat, D., Langlois, S., Wilson, R.D. SOGC Guideline No. 261. Prenatal screening for fetal aneuploidy in singleton pregnancies. J Obstet Gynaecol Can 2017;39:e380-e94.
4. Langlois, S., Brock, J-A. Current status in non-invasive prenatal detection of Down syndrome, trisomy 18, and trisomy 13 using cell-free DNA in maternal plasma. J Obstet Gynaecol Can 2013;35:177-81.
5. Audibert, F., et al. No. 348-Joint SOGC-CCMG Guideline: Update on prenatal screening for fetal aneuploidy, fetal anomalies, and adverse pregnancy outcomes. J Obstet Gynaecol Can 2017;39:805-17.
6. Navaratnam, K., Alfirevic, Z. The Royal College of Obstetricians and Gynaecologists. Amniocentesis and chorionic villus sampling: Green-top Guideline No. 8. BJOG 2021; https://doi.org/10.1111/1471-0528.16821.
7. Cunningham, F.G., et al. Prenatal diagnosis, in Williams Obstetrics, 25th Edition. New York, NY: McGraw-Hill Education; 2018.
8. Sachs, A., et al. Recommended pre-test counseling points for noninvasive prenatal testing using cell-free DNA: a 2015 perspective. Prenat Diagn 2015;35:968e71.
9. Nakic Rados, S., Kosec, V., Gall, V. The psychological effects of prenatal diagnostic procedures: Maternal anxiety before and after invasive and noninvasive procedures. Prenat Diagn 2013;33:1194-200.
10. Awomolo, A., et al. Trends in invasive prenatal diagnostic testing at a single institution. Prenat Diagn 2018;38:735-9.
11. Langlois, S., et al. Comparison of first-tier cell-free DNA screening for common aneuploidies with conventional publically funded screening. Prenat Diagn 2017;37:1238-44.
12. Dougan, S.D., et al. Performance of a universal prenatal screening program incorporating cell-free fetal DNA in Ontario, Canada. CMAJ August 03, 2021 193(30):E1156-E1163; DOI.
13. Brock, J.K., Walsh, J.D., Allen, V.M. The effect of fetal Trisomy 21 on adverse perinatal obstetrical outcomes in Nova Scotia, 2000-2019. J Obstet Gynaecol Can 2021;43:583-8.
14. Nshimyumukiza, L., et al. Cell-free DNA-based non-invasive prenatal screening for common aneuploidies in a Canadian province: A cost-effectiveness analysis. J Obstet Gynaecol Can 2018;40:48-60.
15. Beulen, L., et al. The consequences of implementing non-invasive prenatal testing in Dutch national health care: A cost-effectiveness analysis. Eur J Obstet Gynecol Reprod Biol 2014;182:53-61.
16. Neyt, M., Hulstaert, F., Gyselaers, W. Introducing the non-invasive prenatal test for trisomy 21 in Belgium: A cost-consequences analysis. BMJ Open 2014;4:e005922.

nova scotia health

Congratulations to all Dalhousie Medicine 2022 graduates!

You can be the type of physician you truly want to be here in Nova Scotia. Big enough to provide endless opportunities, yet small enough to make those opportunities your own. Become a key part of the community—both professionally and personally—wherever you decide to live.

We wish you the best in the next stage of your career. Our Physician Recruitment team is here to find the perfect fit for you. Connect with us at MoreThanMedicine.ca.