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Editorial Board

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Land Acknowledgement

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We respectfully acknowledge the territory in which we gather as the ancestral homelands of the Beothuk, and the island of Newfoundland as the ancestral homelands of the Mi'kmaq and Beothuk. We would also like to recognize the Inuit of Nunatsiavut and NunatuKavut and the Innu of Nitassinan, and their ancestors, as the original people of Labrador. We strive for respectful relationships with all the peoples of this province as we search for collective healing and true reconciliation and honour this beautiful land together.

Editorial

Sex and gender bias in medical research: A barrier to equitable patient care

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Keywords: Sex, Gender, Medical Research, Health Equity, Medical Education

Sex and gender influence nearly every aspect of life. Yet many systems, standards, and everyday experiences are designed with the biological male as the default. Standard office temperatures are set to male metabolic rates, crash test dummies are modelled on male physiques, and even language often treats the masculine as the universal norm.[1] These examples illustrate the 'masculine default' – a cultural bias that centers male experiences as the norm, rendering women and gender-diverse individuals invisible or secondary.[2] Unfortunately, medicine, a field that fundamentally impacts human health and well-being, is no exception. From its historical roots to modern day, medical research has been grounded in a male-centric framework,[3] leaving critical gaps in our understanding of women's health. This paper explores how sex and gender bias persist in medical research and examines the downstream effects on patient care and health outcomes.

Before further discussion, I would like to acknowledge that sex and gender are distinct concepts: sex refers to an individual's biological characteristics, such as chromosomes, hormones, and reproductive anatomy, whereas gender is a societal construct that relates to one's identity and expression, which can vary widely across individuals and cultures. Both sex and gender play important roles in medical research and patient care. While not all individuals assigned female at birth identify as women, the literature cited here uses "female" and "women," and this editorial aligns with that terminology.

Historically, females were excluded from medical research. Clinical studies were conducted predominantly on male subjects, with findings generalized to the entire population without accounting for sex-specific physiology.[4] Several factors have been proposed to explain this disparity, including the perceived complexity of accounting for hormonal fluctuations,[5–7] concerns over fertility or pregnancy risks,[8] and systemic bias in male-dominated research and funding bodies.[9,10] The assumption that the male body represented the human "norm" further reinforced this exclusion.[7,11]

Assuming that male-derived data can be universally applied to women poses serious implications for patient care. Firstly, many diseases have sex-based presentations, with cardiovascular disease being a prime example. Women experiencing acute coronary syndrome are more likely to present with symptoms often labelled as "atypical" – including nausea, vomiting, and shortness of breath – rather than the "classic" chest pain described in men, leading to misdiagnosis and delays in treatment.[12,13] Medication efficacy also differs by sex. The Physicians' Health Study, conducted exclusively in men, found that aspirin significantly reduced myocardial infarction (MI) risk,[14] shaping its widespread use for primary and secondary prevention. However, the Women's Health Study revealed a different benefit profile: aspirin had no significant effect on MI primary prevention in women but significantly reduced the risk of stroke and ischemic stroke,[15] a benefit not observed in men.[16] These findings underscore that sex-specific medication responses can be substantial, and failing to recognize these differences risks suboptimal care for women with cardiovascular disease. Finally, drug metabolism and clearance also differ by sex. Women often have higher blood drug concentrations and slower elimination times when given standard doses, increasing the risk of adverse drug reactions.[17] For example, systemic clearance of the anticoagulant lepirudin is 25% lower in women,[18] remaining detectable in circulation for up to 48 hours in women compared to 2 hours in men, greatly increasing bleeding.[19] These findings suggest that current dosing practices may routinely overmedicate women, placing them at unnecessary and preventable risk.

While the inclusion of female participants in medical research has improved,[20–23] underrepresentation persists.[24] Even when women are included, sex-specific analysis is often lacking.[11,17,25] Zucker et al. found that fewer than half of the studies including both sexes accounted for sex in study design or data analysis.[17] Similarly, Welch et al. reported that in a review of randomized controlled trials in Canada, none accounted for the influence of sex, and only 6% performed sex-specific analyses.[26] This lack of sex-based analysis is deeply problematic, as it risks overlooking sex differences that could significantly affect health outcomes for women.

These sex disparities extend to clinical practice guidelines. A 2017 Canadian systematic review found only 35% of guidelines reported screening, diagnosis, or management considerations specific to sex or gender.[27] Even when sex differences were noted, clinical implications were often absent.[27] For example, Canadian Diabetes Association guidelines reported sex differences in response to type 2 diabetes medication in children and adolescents but did not recommend distinct treatments.[28] Guidelines translate research into clinical practice,[27] and omitting sex differences risks one-size-fits-all recommendations that fail to serve all patients.

To address sex and gender disparities in medicine, integrating sex- and gender-based medicine (SGBM) into the medical curriculum is essential. SGBM acknowledges differences in disease diagnosis, treatment, and prognosis between men and women.[29] Educating future physicians on these differences allows them to personalize treatment and reduce disparities in care. Teaching SGBM is therefore fundamental – not only to improve clinical decision-making but to foster equitable, evidence-based therapies that respect the distinct physiology and pathophysiology of all patients.[30,31]

Despite this, SGBM remains poorly represented in medical education. A survey of Canadian and U.S. medical schools found that 70% had no formal sex- or gender-specific content integrated into their curricula.[32] At Yale School of Medicine, only 8% of pre-clerkship lectures and workshops discussed the influence of sex and gender on human physiology and pathophysiology.[33] This lack of integration is not unique to North America. A study in Switzerland found medical students perceived inadequate SGBM integration into lectures and exams and expressed a desire for more.[34] Similarly, a survey of physicians in Israel reported low-to-moderate exposure during training and strong support for greater integration.[35] As Mattioli et al. said, "Teaching gender and sex differences is fundamental in medical classes because it has a strong impact in reducing disparity in treatment, in defining effective and personalized therapies that respect the different physiology and pathophysiology of women."[36] Without formal education, future physicians remain ill-equipped to identify sex- and gender- specific differences, perpetuating inequities in medical care.

In conclusion, progress has been made, but significant gaps remain. Canada has taken meaningful steps towards the integration of sex and gender into health research, as demonstrated by the Canadian Institutes of Health Research (CIHR)'s 2021 Sex and Gender-Based Analysis Plan (SGBA), which mandates sex and gender considerations in study design and practice for funded research.[37] However, enforcement remains inconsistent, leaving significant gaps in achieving equity in research and patient care. To close these gaps, action must be taken. Physicians should critically evaluate the origins of clinical guidelines, assess their applicability to specific patient populations, integrate sex-based analysis into research study designs, and advocate for the inclusion of women and underserved populations in medical research. Achieving a more equitable healthcare system will depend on the next generation of physicians taking responsibility for driving this change.

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Original Research

A student survey exploring app-based radiologic anatomy flashcards for medical education

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ABSTRACT

Background: Online learning tools are common in medical education, including digital flashcard sets on web-based apps viewed using a computer or mobile device. However, existing research on apps for learning radiologic anatomy is limited, and further examination of the educational outcomes of using smartphones versus other electronic devices is needed.
Methods: Digital flashcards of radiologic anatomy were created by editing images in PowerPoint and uploading them to an online app (Quizlet). Participants reviewed the flashcard sets on a device of their choosing, either a smartphone or a computer. An online survey was distributed. Anonymous recruitment of medical students and residents at a single university occurred between 2022 and 2024.
Results: Of the 32 respondents, 21 (65.6%) viewed the flashcard sets using a computer, and 11 (34.4%) used a smartphone. Common themes were identified regarding the preference for viewing flashcards on either a computer or smartphone. Regardless of the device, most participants (93.3%, n = 30) agree that digital flashcards are beneficial for learning radiologic anatomy.
Conclusions: Findings suggest that app-based flashcards are a beneficial learning tool for radiologic anatomy. While smartphone accessibility is convenient, our respondents preferentially chose a computer for flashcard review due to its larger images, easier platform to navigate, and fewer distractions (e.g., phone notifications). Future work could evaluate the efficacy of each device for learning radiologic anatomy.

Keywords: Radiology, Anatomy, Application, Flashcards, Medical Education

INTRODUCTION

Medical trainees are required to learn a growing volume of information, albeit while their time in a traditional classroom setting is limited.[1] Due to advances in software and connectivity, online learning tools are playing a more significant role in medical education.[2,3] Of these tools, the most commonly used are web-based applications viewed on the internet or a smartphone application.[2] Such tools provide unlimited access to educational resources in a way that is convenient, efficient, portable, and flexible.[1,2,4,5]

Web-based applications enact the principle of "microlearning," whereby students engage in short teaching sessions throughout the day.[2] Healthcare is a fast-paced environment with frequent updates in clinical practice. Thus, smartphones are increasingly used to access medical information and guidelines anytime and anywhere.[1,3,5-9] In 2017, a survey of medical students at a university in India found that over 90% (n = 446) felt smartphones were helpful in medical education.[10]

Flashcards are an established study tool in medical education.[4,11,12] They utilize the principle of spaced repetition, which is a more effective study technique than short-term mass revision.[11] This is useful for studying anatomy, which has been described as repetitive and time-consuming.[2,5,6] Digital flashcards have several advantages, including being accessible anywhere, enabling detailed analysis of self-testing, and allowing for relatively quick review as needed.[5,12] Anatomy apps have become a valuable resource for medical students, particularly those in programs that do not include cadaver labs.[7]

Students commonly use web-based applications such as Quizlet to create and review digital flashcard sets.[7] It has been reported that students who used Quizlet preferred reviewing text and anatomical images using their smartphone rather than a computer.[7,12] This was due to smartphone portability and processing speed. On the contrary, the main limitations of studying flashcards on a smartphone are the small screen size and the resulting eyestrain.[12] Importantly, according to the American College of Radiology (ACR), smartphone image quality is not yet sufficient for diagnostic purposes, though it can be suitable for teaching.[13-15]

Smartphones and computers were chosen for comparison as they are both commonly owned and used for studying by the modern student. Limited research exists on student preference for using smartphones versus other electronic devices for medical education.[1,12] More specifically, there is a lack of research on these preferences regarding web-based applications for learning radiologic anatomy. The intended purpose of these digital device aids is to optimize information processing and increase content accessibility, albeit while balancing their risk of cognitive overload by distractors and unintentional multitasking [16]. Regarding this balance, one device does not fit every individual's needs, and it may vary depending on the learning environment or study content. Thus, this study aims to explore learners' satisfaction and perceptions towards using radiologic anatomy digital flashcard sets on their smartphones or computers. If this is

better understood, efforts towards learning resource creation could be appropriately targeted towards a modality that is more likely to engage the students and increase their overall usage.

METHODS

Study Design

The flashcard sets were created using original material sourced from the Memorial University of Newfoundland (MUN) diagnostic radiology residency program director (Figure 1). Images were edited in PowerPoint and then uploaded to the app Quizlet. There is an option for medical student or resident-level content. A detailed list of the content covered by each flashcard deck can be found in Figure 2.

This is a one-group post-survey study with a pre-experimental study design. Participants reviewed the flashcard sets on a device of their choosing, either a smartphone or a computer. Survey creation, distribution, and data storage were performed using Qualtrics software, an online survey tool institutionally approved by MUN. The survey consists of three short answer questions and eight five-point Likert-scale assessments (available upon request).

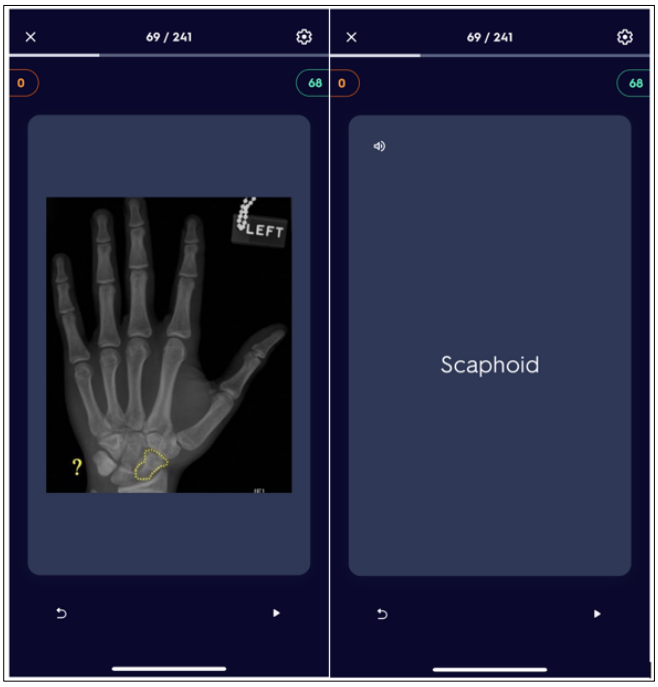

Figure 1. *Smartphone screenshots of a "Quizlet" flashcard from the "MSK" set in the "MUN Medical Student Radiological Anatomy" class.*

Medical Student Level	Radiology Resident Level
Abdominal Viscera	Abdominal Angiogram Anatomy
Abdominal Wall and Inguinal Region	Abdominal Ultrasound Anatomy
Abdominal X-Ray Anatomy	Chest Vascular and Bronchus Anatomy
CT Vascular Anatomy	Chest Vascular and Coronary Anatomy
MSK	Chest X-ray and CT Anatomy
Pelvic Anatomy and Bones	Coronary CT Vascular Anatomy
Pelvic Musculature	Head and Neck Vascular Anatomy
Radiographic Vascular Anatomy	Head MRI Anatomy
Skull, Spine & Vessels	IR Carotid Vascular Anatomy
Urogenital Systems	IR Celiac and SMA Vascular Anatomy
	IR Pancreatobiliary Anatomy
	IR Vascular Anatomy
	Liver Segment and Abdominal Compartment Anatomy
	Lung Segment Anatomy
	MSK Lower Limb
	MSK Pelvic MRI Anatomy
	MSK Upper Limb
	MSK X-Ray Anatomy
	Sagittal MRI of the Knee
	Skull X-Ray Anatomy
	Suprahyoid Neck CT Anatomy

Figure 2. *List of entitled flashcard decks.*

Setting and Recruitment

Participants were eligible to participate if they were current medical students or radiology residents at MUN. This target audience was selected as the digital flashcard sets had been made available to MUN students since their creation in 2019, therefore they would be the most familiar with their content and utility. Anonymous recruitment occurred over two years (October 2022 to March 2024) via institutional email dissemination, in-class promotion, and sharing on the local Radiology Interest Group's private social media page. Given these parameters, we reached 5 medical school classes (approximately 80 students per year) and 6 resident cohorts (approximately 3 students per year), totalling a target audience of 418 students. With an expected survey response rate of 5-10%, the number of potential respondents ranged between 21 to 42 people.

Participants who completed the survey were entered into a random draw to win a gift card valued at CAD 20.00. Survey instructions include a link to a guide on accessing and navigating the Quizlet flashcard sets (available upon request). Informed consent was obtained, and the study was approved by the Newfoundland and Labrador Health Research Ethics Board (Reference # 2022.118).

Data Analysis

Descriptive statistics in the form of proportions/percentages were implemented to compare the participants who preferred using their smartphone or computer, as well as to analyze the responses in each arm of the Likert scale. Using a thematic analysis framework, common themes were identified from open-ended feedback.

RESULTS

The survey received 32 responses (7.7% of the target audience). Of these participants, 25 (78.1%) were medical students, six (18.8%) were radiology residents, and one (3.1%) responded "other" but did not specify their position. The largest cohort of responses came from first-year medical students (n = 9, 28.13%). These demographics are detailed in Table 1.

Table 1. *Training level of the survey participants. MS = medical student. R = radiology resident. Number (i.e. 1) = year of program.*

Training Level	Count (%)
MS1	9 (28.1%)
MS2	5 (15.6%)
MS3	6 (18.8%)
MS4	5 (15.6%)
R1	1 (3.1%)
R2	2 (6.3%)
R3	1 (3.1%)
R4	2 (6.3%)
R5	0 (0.0%)
Other	1 (3.1%)

Of the 32 respondents, 21 (65.6%) viewed the flashcard sets using their computer, and 11 (34.4%) used their smartphone. Of the 25 medical students, 17 (68.0% of medical students, 53.1% of total respondents) used their computers, while eight (32.0% of medical students, 25.0% of total respondents) used their smartphones. As for the 6 residents, four (66.7% of residents, 12.5% of total respondents) used a computer, and two (33.3% of residents, 6.3% of total respondents) used their smartphone. The single respondent with the training level "other" used their smartphone (3.1% of total respondents). A detailed breakdown is depicted in Figure 3.

Two of the 32 respondents did not complete the Likert-scale assessment or open-ended questions, and their responses were not included in the analysis. Therefore, the analysis of the survey questions included 30 respondents. Regardless of the chosen device, the majority (93.3%) agreed that digital flashcards are beneficial for learning radiologic anatomy. They indicated a slight preference for viewing these on their computer (20.0%) over their smartphone (13.4%), while others had a neutral opinion (23.3%) or responded "not applicable" (43.3%). A detailed presentation of the Likert-scale assessment can be seen in Table 2.

The common themes identified regarding the respondent's preference for using a computer include larger images, an easier platform to navigate, and fewer distractions (i.e. phone notifications). The main reason participants preferred the smartphone was its availability and portability. Regarding general comments on the flashcard sets, respondents stated the guide on navigating Quizlet is beneficial, and repetition of flashcards in different sets helped reinforce their learning.

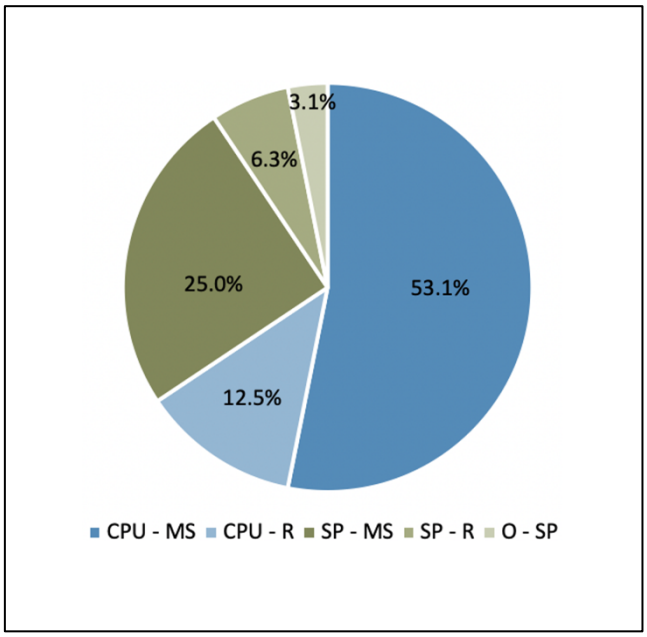

Figure 3. *Breakdown of respondent device usage (n = 32; MS = medical student, R = resident, O = other, CPU = computer, SP = smartphone).*

DISCUSSION

Nearly twice as many participants chose to review the flashcard sets using their computers, which was similar between medical students and residents. Moreover, they indicated a slight preference for using their computer over their smartphone as the images could be larger, there were fewer distractions from smartphone notifications, and the online platform on the computer was easier to navigate. These results are in contrast to prior research, which shows that students who used Quizlet preferred using their smartphones.[7,12] A possible reason for this contradictory finding could be that the prior studies did not discuss the review of detailed radiographic grey-scale images that require larger and better-quality pictures, which are generally more feasible on computers instead of smartphones [12-15]. A second potential influence is that one of the two previous studies was published in 2014 (the other being more recent in 2020), and since this time, smartphones have become increasingly more advanced with a greater potential to cause distraction through ample pop-up notifications. For example, a 2014 article quoted that people received an average of 63.5 smartphone notifications per day, while another published in 2024 found an increase of up to 146 per day, which was even greater for young adults [17,18]. It is well documented that smartphone notifications are distracting, and this increase over time could have possibly led to our participants preferring to study using their computers [19,20]. Direct quotes from participants that

Table 2. *Participant's level of agreement with various statements.*

Statement	Not Applicable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I found this flashcard set helpful for radiologic anatomy comprehension.	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (6.7%)	15 (50.0%)	13 (43.3%)
I found this flashcard set more effective than reading textbook/lecture material alone.	0 (0.0%)	0 (0.0%)	1 (3.3%)	1 (3.3%)	20 (66.7%)	8 (26.7%)
I would recommend this flashcard set to colleagues.	0 (0.0%)	0 (0.0%)	1 (3.3%)	3 (10.0%)	19 (63.3%)	7 (23.3%)
I will use this flashcard set again.	0 (0.0%)	1 (3.3%)	0 (0.0%)	9 (30.0%)	13 (43.3%)	7 (23.3%)
The learning content was appropriate for my stage of learning.	0 (0.0%)	0 (0.0%)	1 (3.3%)	3 (10.0%)	17 (56.7%)	9 (30.0%)
The smartphone image quality was appropriate.	17 (56.7%)	0 (0.0%)	0 (0.0%)	1 (3.3%)	9 (30.0%)	3 (10.0%)
The computer image quality was appropriate.	3 (10.0%)	1 (3.3%)	0 (0.0%)	4 (13.3%)	15 (50.0%)	7 (23.3%)
I prefer this flashcard set on my mobile device (not my computer).	13 (43.3%)	1 (3.3%)	5 (16.7%)	7 (23.3%)	2 (6.7%)	2 (6.7%)

reflected these findings were "I prefer to study and view medical images on a larger screen (i.e. my laptop/computer), and try to have less apps on my phone" and "The computer is less distracting and does not receive as many notifications as a smartphone."

Participants stated that smartphones are more readily available and portable, which is consistent with previous literature.[1,2,4,5] One participant answered, "I always have my phone on me and it is easy to open up - I don't always have my computer and it takes longer to open and start things on." We expected this to significantly influence device choice, given the typically busy and fast-paced healthcare environment whereby medical students/residents attempted to complete the flashcards. However, for the reasons discussed above, participants cited more positive aspects of reviewing the flashcards using a computer.

Regardless of the device used, the majority of participants had a positive opinion of the flashcard sets. Most participants found them to be a beneficial learning tool for radiologic anatomy, an adjunct to reading text, and that the image quality is appropriate.

When designing digital flashcard sets for students, providing the learner with a guide on how to use the app is beneficial. Repeating similar flashcards in different sets also helps to reinforce essential details. A participant stated "The repetition of flashcards helps to reinforce learning. I particularly liked the fact that there were several repeated cards in various sets." Regarding designing flashcards for smartphones, the ability to provide focused and zoomed-in images of specific anatomy may allow for easier viewing. These are key concepts for educators to consider in the future.

Limitations

As this is exploratory research using a one-group post-survey study, with a pre-experimental study design, there are inherent limitations. Without control groups or random assignment,

this study cannot establish causality as to how or why participants chose to use a computer or smartphone. Additionally, the study's generalizability is limited by its one-group analysis with a small sample size, particularly for the resident cohort.

As per the devices used in this study, smartphones and computers are common learning tools among today's students, therefore we assumed all participants had access to these devices. Additionally, image quality and device picture settings were not standardized as participants had the freedom to choose which personal device they used to view the flashcard sets. This could also implement a self-selection bias. Lastly, participants were not made to use both a smartphone and a computer. Therefore, their opinions in this study were formed without comparison to the alternative device.

Future Considerations

This study explored device preference for reviewing radiologic anatomy flashcards by allowing participants to choose which of their own personal devices they used. In order to standardize device image quality and settings, as well as to remove selection bias, a future study could have participants use specific models of both a computer and a smartphone and subsequently make a preference judgement.

This study does not directly evaluate the impact of each device on learning outcomes such as comprehension, recall, or retention. Further research into which device optimizes these learning outcomes would be helpful in guiding students so that they can obtain the greatest value from their study time. The efficacy of these devices could be assessed by implementing pre- and post-testing of radiologic anatomy after reviewing digital flashcard sets and then subsequently conducting long-term follow-up to evaluate for content retention.

Furthermore, in an effort to improve the sample size, generalizability, and infer causality, the target audience could be expanded to involve additional medical schools, groups could be designated to review the digital flashcard sets with only a computer or a smartphone, and there could be a control group that studies the material by reading the content without the aid of flashcards.

Finally, resident training level and learning experiences differ from those of medical students. If more residents were recruited from other institutions, the data analysis could explore differences between the preferences and learning outcomes of these two groups.

CONCLUSION

App-based flashcards are a beneficial learning tool for radiologic anatomy. While smartphone accessibility is convenient, the participants in our study preferentially chose a computer for flashcard review. Future research could address the efficacy of these devices for learning radiologic anatomy.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

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Perspective

The water keeps rising: A perspective article on Canadian health expenditure

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This article is meant to bring attention to a recent update published by the Canadian Institute for Health Information (CIHI), sparking discussion on the topic of money and healthcare and includes personal opinion regarding the current state and future of private health expenditure in Canada.

Each year, the CIHI releases a publication on national health expenditure trends.[1] This yearly document provides a breakdown on healthcare and money in Canada, outlining how spending is divvied up in terms of public and private expenditure, while highlighting comparisons in spending at provincial, territorial, and international levels. This document is developed using information from the National Health Expenditure Database (NHEX). Estimates of health expenditures are made for 2023 and 2024, and the actual health expenditures for 2022 are included.

The national health expenditure trends have been broken down into three documents for 2024, with an infographics document, snapshot document and a larger release summary. Diving first into "the big one", total healthcare spending in Canada is expected to reach $372 billion in 2024.

Take a moment and look at that number again.

$372 billion.

$372 billion would represent 12.4% of Canada's Gross Domestic Product (GDP), making it the highest ratio of GDP allocated to healthcare ever in Canada, excluding 2020 and 2021 when a global pandemic threw healthcare expenditure and the healthcare world upside down.[1] Health expenditure is expected to increase in all areas, with hospital expenditures increasing over 6% both in 2023 and 2024, physician expenditures jumping by 7.5% in 2023 and 4.4% in 2024, and drug expenditure rising by 5.6% in 2023 and 3.8% in 2024.

All these increases are expected to result in a 4.5% and 5.7% increase in total health expenditure in 2023 and 2024, respectively. The last time total healthcare expenditure rose by this much was between 2008 and 2010, where they increased by an average of 5.9% per year. If you're trying to remember what happened in 2008-2010, they were the years of the most recent economic recession in Canada.[2] Some reasons that have been provided for this spike in expenditure include the "tail-end" of the pandemic and an aging population in Canada.[1] Of note, a record increase of population growth also occurred in 2023, which was the first time where population growth in Canada exceeded one million since comparable population data has been collected.[3]

So what?

What's the impact?

Why does it matter if the costs keep increasing in a free healthcare system?

The answer is that it wouldn't matter if we actually had a "free" healthcare system in Canada, but many times there are some forms of private expense for access to healthcare. The Organization for Economic Co-operation and Development (OECD) is an organization centered in economic policy improvement by providing insight and statistics on multiple countries.[4] Based on OECD data, Canada's share of private health expenditure in 2022 was *28.8%*. Outside of the United States (US), this was the highest share of private health expenditure when comparing other similar OECD countries, including: Australia, New Zealand, United Kingdom, Netherlands, France, Sweden and Germany. This percentage was also higher than the OECD average of all 38 member countries (25.3%), placing Canada in the highest quarter in terms of share of private health expenditure for OECD member countries.[5]

28.8%.

Applying this percentage to Canada's expected total health expenditure of $372 billion dollars means that the share of private health expenditure would equal $107.1 billion. It's hard to argue that we have a free healthcare system when we could spend over $100 billion dollars on private healthcare in 2024.

Again, so what?

I don't pay to go to the hospital, so what even is included in private health expenditure?

In the national health expenditure trends document, private health expenditure consists of private, voluntary health insurance payments and out-of-pocket costs.[1] Out-of-pocket costs are expenditures that are borne directly by a patient where neither public nor private insurance cover the full cost of the health good or service.[6]

Though not specified within the national health expenditure trends document, other studies have identified the growing amount of out-of-pocket costs in Canada.[6-8] To start, the Canadian household average for private payments in six categories of healthcare services (prescription drugs, dental care, eye care, physicians, hospitals and nursing homes, and for other healthcare practitioners) was 37% higher in 2009 when compared to costs in 1998, totalling $19.8 billion in

2009.[7] Expenditures in every category were still higher on average after adjusting for inflation, demonstrating that the cost to access healthcare is not encompassed by Canadian Medicare. These rising costs only bring trouble to the Canadian population, as increased private financing is found to negatively affect accessibility, universality, and quality of care without improving health outcomes or health expenditure growth rates.[8]

Of special consideration is this journal's home province of Newfoundland and Labrador (NL), where there is a much lower population density compared to the national average, with over 50% of the population living outside of a census metropolitan area or a census agglomeration.[9] This higher proportion of the population living rurally means that patients are more likely to have to travel for healthcare in larger centres for specialized treatments, have a longer length of stay, and are more likely to incur out-of-pocket costs related to productivity loss, temporary housing, transportation, and many more.[6]

If people are spending so much, what's being done?

Why isn't anyone talking about this?

The national health expenditure trends article discussed how new healthcare legislation is focusing on reducing Canadians' out-of-pocket medical expenses. This includes the Canadian Dental Care Plan (CDCP) and Bill C-64 (An Act Respecting Pharmacare). As noted in the article, while these policies will reduce the out-of-pocket costs for these services, total health expenditures could increase as more patients begin using these services.[1]

There was also discussion about how provinces and territories are starting to fund more surgeries in private clinics. This would certainly have an impact on public health expenditure, as more surgical sites would mean that more surgeries could happen each day, meaning more billing could be processed each day. Apart from the public health cost, the funding of private clinic surgeries could also be expected to reduce wait times for in-hospital surgeries, which would be of benefit to the patient population.

In terms of the lack of discourse surrounding out-of-pocket costs in Canada, I believe that other prominent issues in medical care (shortages in primary care staff, emergency department wait times, etc.) are overshadowing thoughts of how cost is impacting access to care. Along with this, there is still a popular notion that the Canadian healthcare system is free. This idyllic belief brings comfort to many, but continuing to ignore these costs is only treading water. In the most recent cycle of the Canadian Social Survey on Quality of Life and Cost of Living from 2022, over one-quarter (26%) of Canadians reported they would be unable to cover an unexpected expense of $500.[10]

To fix this, innovative interventions need to be implemented continuously to work towards reducing the cost of healthcare. There is no one solution, nor is there any idea/initiative that is better than another, and I am not someone who has all the answers. As stated at the beginning of this article, I want to bring awareness to the current and future state of expenditure in the Canadian healthcare system, enabling more people to be aware and consider what this means from their perspective for the future of healthcare. Take a moment and consider what solutions you believe could help with navigating this issue.

To close, I leave everyone with one question. Should we allow people to continue thinking that we have a free healthcare system, or is it better to be open and honest about the expensive nature of healthcare in Canada so we can work towards finding solutions before we all have to start wading through costs to access care?

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Original Research

The impact of schooling context through COVID-19 on strategies for reading on paper and on digital devices

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ABSTRACT

The COVID-19 pandemic significantly impacted children's lives, including school closures resulting in mandatory homeschooling. These school changes have been associated with gaps in educational attainment, and changes in children's screen time. The current study aimed to investigate the reading strategies parents used with their children, how children spent their leisure time, and children's digital reading versus reading on paper during the pandemic. The study compared these variables across three groups: in-person learners, mandated homeschoolers, and voluntary homeschoolers, with further analyses by age group. 961 North American couples with children in Grades 1-5 were surveyed, responding retrospectively on the period of January 15th, 2021, to February 15th, 2021. Voluntary homeschoolers spent more time reading both on paper and on a screen for pleasure than mandated homeschoolers and in-person learners. Families with mandated homeschoolers and in-person learners employed more reading strategies when reading on paper than on screens. These two groups also used reading strategies more frequently with paper than families who voluntarily homeschooled their children. Mandated homeschoolers use more reading strategies with their children on a screen than both in-person learners and voluntary homeschoolers. All three schooling groups used more strategies with younger children compared to older children. Voluntary homeschoolers engaged in almost all activities more often per week compared to mandated homeschoolers and in-person learners. This research highlights differences in reading habits and strategy use among children based on their schooling conditions during the pandemic, which may help explain the emerging gaps in educational attainment related to the pandemic.

Keywords: Reading Strategies, Reading Development, COVID-19, Pandemic

INTRODUCTION

The COVID-19 global pandemic altered children's lives and learning, particularly with the shift from in-person schooling to mandated online learning as part of broader pandemic containment measures[1], implemented with considerable variability.[2] Emerging research has highlighted lower-than-expected reading levels after school closures due to the COVID-19 pandemic[3-5], suggesting that these declines are linked to the closures. Importantly, parents' involvement in reading and literacy activities with their children has been shown to help mitigate pandemic-related learning losses.[6-7] Another challenge of the COVID-19 pandemic has been children's increased screen time[8-10], at a time when digital reading options are becoming increasingly available. Here we explore connections between these shifts, looking at reading habits, reading strategies use, and leisure activity time among North American elementary-aged children in different schooling contexts throughout the pandemic.

Homeschooling During the Pandemic

The COVID-19 pandemic resulted in widespread containment measures; one such measure was the implementation of online home learning, referred to as mandated homeschooling in this study.[1] The implementation of this measure varied across regions.[11] For example, in Nova Scotia, Canada, the winter break for all public schools was extended until mid-January 2021 because of the ongoing COVID-19 pandemic.[12] In contrast, students in the capital city of Newfoundland and Labrador, Canada, were required to change from in-person learning to mandated homeschooling in mid-February 2021, as the province went into lockdown to control the spread of the COVID-19 virus.[13] To assess the impacts of schooling, we surveyed families whose children were voluntary homeschoolers (i.e., homeschooling for reasons unrelated to COVID-19), mandated homeschoolers (i.e., learning at home due to COVID-19), and in-person learners (i.e., attending school in person).

Leisure Activities

Mandated lockdowns restricted outdoor activities and increased screen time for children of all ages.[14,9,8,15] These shifts were most pronounced in older children. For instance, McArthur et al. (2021) showed that screen time increased by an hour a week (from 10 to 11 hours) for children ages 5 to 8, but doubled for children ages 8 to 9 (from 12 to 24 hours). These levels of screen time stand in stark contrast with Canadian guidelines for children's screen time, which range from 0-2 hours of screen time a day, increasing with age.[16-17] Research in Germany revealed that, while children spent more time playing outside once pandemic restrictions eased,

they engaged more in indoor and creative activities at the outset of the pandemic.[18] It is not clear whether these changes in leisure activities were primarily driven by changes in schooling—such as the closure of in-person learning—or due to the variety of other changes in routine brought on by the pandemic.

The Pandemic and Literacy

The elementary school years are an important time in reading development, as children transition from "learning to read" to "reading to learn" around grades 3 to 4.[19] The early stage of reading is heavily dependent on the ability to decode printed text.[19] As children progress, reading strategies evolve with an emphasis on techniques that support reading comprehension.[20]

Reading Modality

As technology becomes increasingly incorporated into our society, coinciding with the pandemic shift to mandatory homeschooling which was often delivered online, it is of interest whether the pandemic resulted in a change in the modalities that children are using to read for pleasure. Research has begun to investigate this question. Read et al. (2021) surveyed parents with young children, ages 2-5, and asked them to self-report retrospectively on their literacy practices with their children before (February 2020) and during (October 2020) the pandemic lockdowns. The researchers examined factors such as reading frequency, the number of people that read with the child, and whether reading took place on paper or on a screen. While there was no significant change in reading frequency pre-and-during pandemic, parents reported a significant increase in reading on a screen, and a decrease in the number of people who read with the child.

Reading Strategy Use

Reading strategies are important tools in children's reading comprehension. These strategies are often used during shared book reading, which has been shown to benefit various elements of children's reading development.[21-23]

Given the variation in the amount of online learning during the pandemic, it is of interest whether children's use of reading strategies, as well as the medium they use (i.e., paper or screen), changed during this time period. Past research and practical guidelines have focused on which reading strategies are most effective for school-aged children to improve their word decoding, text comprehension, and connect ideas in the text to past knowledge. McKeown et al. (2009) examined various paper reading comprehension strategies used by teachers with their students in Grade 5, and found higher comprehension scores when reading strategies focused on text meaning (i.e., summarizing main ideas and asking questions during reading). Furthermore, the Institute of Education Sciences also recommends that educators ask content-related questions to test children's comprehension of text and encourage inference-related questions that go beyond literal understanding (i.e. asking a child *how* or why they know the answer to a content-related question).[20] For younger children, common paper reading strategies include sounding out words and asking questions about word meanings[25], whereas for older children, strategies such as recapping the contents of a text and checking comprehension are more effective.[25]

While research supports various reading strategies on paper, less is known about children's use of similar and different strategies while reading on a screen. Although reading strategies can be implemented while reading both on paper and on a screen, certain features that are unique to online reading (i.e., hyperlinks and easy access to word definitions) could alter how reading strategies are applied. These digital tools could either supplement or replace traditional strategies (i.e., online word definitions in lieu of inferring word meanings from context). Research has indicated that while certain reading strategies suggested for paper reading (i.e., checking understanding of the text and connection to prior knowledge) may be used while reading on a screen, the digital environment may require the use of other strategies such as navigating digital features and judging the reliability of a reading source.[26-28]

Research has begun to examine the home literacy practices of children and students of a variety of ages during the pandemic.[29-30] One comprehensive study compared the home literacy and home reading practices of families in Israel, Spain, and Bulgaria, comparing the timepoints of spring 2020, at the onset of the pandemic, to spring 2021.[9] The researchers examined three categories of home literacy activities including "shared book reading" (a variable we examined in the current study), as well as children's independent screen time. Findings showed that children spent more time on screens independently at the first timepoint, whereas parents engaged in more shared book reading with their children at the second timepoint. This research suggests that as the pandemic progressed, parents may have adapted to the novel circumstances, allowing for increased engagement in shared reading activities over time.

Examining reading and writing strategies, López-Escribano et al. (2021) surveyed parents with children between the ages of 2 to 9 years old by asking them to report on the period of April and May 2020, a time of mandated confinement and school closures in Spain. Using a latent class cluster analysis, the researchers classified families into four subgroups based on the reading and writing strategies used during lockdown: (1) Prioritizes writing activities (i.e., focused on school-based tasks such as name writing, copying letters and words; 52.5% of families), (2) Interested in practicing all types of literacy activities (i.e., interested in writing activities, dialogic-creative activities, reading activities, and digital literacy activities; 18.9% of families), (3) Willing to do digital activities (i.e., watching/listening to e-books, playing digital reading games; 15.1% of families), and (4) Ready to practice dialogic-creative activities (i.e., playing using letters, using

interactive dialogue about a text; 13.6% of families). The largest group, those prioritizing writing activities, participated less in digital activities and primarily centered literacy practices around school-related tasks. Additionally, older children were most represented in the "willing to do digital activities" cluster.[31]

Because of the importance of reading strategies in aiding with reading comprehension, and the evidence for pandemic-related learning losses, examining reading strategy use across schooling groups is of great interest. It is suspected that because of the pandemic and the shift to online learning, both reading on a screen and the use of digital reading strategies may have increased.[9-10] At the same time, paper strategies may have remained prevalent among families during the pandemic.[31] When comparing co-occurring schooling pandemic learning conditions, mandated homeschoolers may have utilized reading strategies more frequently than the other schooling groups, because their learning situation closely resembled pandemic lockdowns studied in the above research.

The Present Study

The objective of this study is to explore how changes in education brought on by the COVID-19 pandemic may have influenced how children are spending their time, including changes in reading formats (from paper to digital) and how reading strategies are being used, particularly whether these patterns are influenced by age and access to internet. Existing literature has shown an increase in digital reading when considering pre-pandemic and during-pandemic time periods.[9-10] In terms of reading and other literacy strategies, some studies have shown that during the pandemic, parents engaged in more writing-dominant activities (e.g., did more writing activities with their children than other types of literacy activities) compared to reading, digital, and dialogic-creative strategies.[31] This study will expand on existing literature by examining differences in digital and print reading strategies, as well as leisure activities, among children learning in one of three schooling conditions: **(1)** mandated homeschoolers (i.e., being schooled at home because of the COVID-19 pandemic), **(2)** voluntary homeschoolers (i.e., being schooled at home for reasons unrelated to the COVID-19 pandemic), and **(3)** in-person learners (i.e., those who were able to attend in-person classes during the COVID-19 pandemic). To analyze the potential impacts of age on reading strategies, leisure activities, and reading, participants were sorted into two groups based on age: younger children (ages 5-7), and older children (ages 8-12). These groups were decided based on the shift seen in reading development around ages 7 or 8.[19] To our knowledge, no research has examined the effect of the above variables on the frequency and type of print and digital reading strategies within the context of the COVID-19 pandemic.

The two central research questions of the current study are **(1)** Did children spend their leisure time differently during the pandemic based on their schooling group and age, including their screen versus paper reading for pleasure? And **(2)** Did families implement different reading strategies, and at different frequencies, with their children based on their school group and age?

Based on the existing literature, it is hypothesized that **(H1a)** mandated homeschoolers will engage in increased screen-based leisure activities, including reading for pleasure on a screen, compared to voluntary homeschoolers and in-person schoolers. However, no significant differences are expected between voluntary homeschoolers and in-person learners.[9,15,10] We expect no differences in paper reading for pleasure across the three groups.[32,10] It is also hypothesized that **(H1b)** older children will spend more time reading for pleasure across paper and digital modalities as compared to younger children, as they may be able to read independently due to their advanced reading skills.[19,31] **(H1c)** does not suggest a direction towards how children are spending their leisure time in the pandemic based on age, due to the lack of existing research examining these specific variables.

Regarding the second research question, it is hypothesized that **(H2a)** mandatory homeschoolers will employ more digital and paper reading strategies compared to voluntary homeschoolers and in-person learners.[31,10] **(H2b)** is that reading strategy type will not differ among the three groups.[9,31,10] However, it is expected that strategy type and frequency will vary by age, with parents employing reading strategies more frequently with older children compared to younger children.[9,25]

METHODS

Participants and Recruitment

In this study, we surveyed 961 couples (average ages in years: 39.13 (SD = 6.70) for in-person learners; 38.70 (SD = 9.61) for mandated homeschoolers; 36.17 (SD = 5.61) for voluntary homeschoolers) with children in Grades 1-5 and asked them to report on their youngest child's amount of time spent reading, as well as their use of reading strategies for both paper and digital reading. Participants were recruited through Qualtrics Survey Panels, an online survey platform. Although couples were recruited, only one partner answered the questions pertaining to schooling, leisure activities, and reading strategies. The study was approved by the Research Ethics Board at Dalhousie University, REB# 2020-5336. Participation in this survey was completely voluntary, and participants were anonymous. Initial recruitment through Qualtrics resulted in 764 initial couples. To increase representation of voluntary homeschoolers in the sample, homeschooling families were additionally recruited via social media and homeschooling groups, which increased the number of voluntary homeschooling couples by 198 couples.

To take part in the survey, participants were required to be 19 years of age or older, have both partners in the couple willing to respond to the survey, be in their romantic relationship for

at least three months, have been living together during January 15th-February 15th 2021, and have at least one child in Grades 1-5. These questions were asked as part of a larger questionnaire designed by the research team to evaluate families' well-being, and their experience engaging in homeschooling, during the COVID-19 pandemic. Participants were asked to reflect on the period from January 15th, 2021, to February 15th, 2021—a period unique to the studied region because of co-occurring mandated homeschooling and in-person schooling.[33] The participants were categorized into one of three schooling groups: in-person learners (n = 385), mandated homeschoolers (n = 332), voluntary homeschoolers (n = 244). The sample included individuals who were located in Canada (n = 800) and the United States of America (n = 154). The average age of child participants in years was 8.64 (SD = 2.75) for in-person learners, 8.80 (SD = 2.86) for mandated homeschoolers, and 8.44 (SD = 2.03) for voluntary homeschoolers. The participants were part of a larger study that examined how romantic couples functioned during the COVID-19 pandemic.

Measures

Demographic Questionnaire

The first part of the survey asked parents to answer demographic questions such as: location of residence, gender and sex, relationship type (i.e., opposite gender, same gender), ethnicity, education level, family income, and employment. The next section asked about their child's demographic information such as: age, gender, ethnicity, diagnosed disability, and enjoyment of schooling.

Table 1. *Parent demographic information.*

Adult Variable	**In-Person Learners (n = 772)**	**Mandated Homeschoolers (n = 664)**	**Voluntary Homeschoolers (n = 488)**
Adult Age - *M(SD)*	39.13 (6.70)	38.70 (6.91)	36.17 (5.61)
Number of Children – *M(SD)*	2.1 (.85)	1.97 (.85)	1.48 (.88)
Adult Gender			
Male	388	334	242
Female	383	328	244
Non-binary	1	2	0
Prefer not to answer	0	0	2
Family Income			
$25,000 or less per year	36	33	8
Between $26,00 and $50,000	78	76	83
Between $51,00 and $75,000	98	110	160
Between $76,00 and $100,000	172	106	122
Between $101,00 and $125,000	110	84	60
Between $126,00 and $150,000	117	94	38
$151,000 or more per year	128	132	10
Prefer not to answer	33	29	7
Highest Level of Education			
Elementary school	0	0	0
Some high school	17	15	10
High school graduate	81	74	44
Some college/university	88	67	130
College/university graduate	414	301	214
Some post-graduate	41	34	57
Post-graduate degree (e.g., Master's, Ph.D., LLB, MD)	131	173	33
Adult Ethnicity			
White	552	438	416
South Asian /Southeast Asian /East Asian (e.g., Chinese, Japanese, Korean)	116	117	21
Latin American	19	25	12
Black	28	19	1
First Nations	5	16	24
Arab / West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)	15	9	2
Multiracial	25	28	6
Other	9	7	2

Table 2. *Child demographic information.*

Child Variable	In-Person Learners (*n* = 385)	Mandated Homeschoolers (*n* = 332)	Voluntary Homeschoolers (*n* = 224)
Average Child Age – *M(SD)*	8.64 (2.75)	8.80(2.86)	8.44(2.03)
Country/Province of Residence			
Canadian	360	281	159
British Columbia	38	15	14
Alberta	72	25	15
Saskatchewan	14	5	4
Manitoba	20	8	4
Ontario	105	200	70
Quebec	67	21	14
New Brunswick	14	3	6
Prince Edward Island	2	0	0
Nova Scotia	19	1	32
Newfoundland and Labrador	6	3	0
Northwest Territories	1	0	0
Other (Canada)	2	0	0
American	22	49	83
Missing	3	2	2
Child Gender			
Female	183	150	76
Male	201	182	168
Non-binary	1	0	0
Prefer not to answer	1	0	0
Child Ethnicity			
White	267	212	203
South Asian/Southeast Asian/East Asian (e.g., Chinese, Japanese, Korean)	48	54	9
Latin American	7	7	3
Black	14	9	1
Indigenous	2	7	2
Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)	6	3	1
Multiracial	33	32	21
Other	9	8	4
Child Disability Diagnosis			
Yes	47	41	20
No	338	290	222
Prefer not to answer	1	1	2

Pandemic Schooling Questionnaire

Panelist A (the member of the couple who responded to the items about schooling, reading, and leisure activities) was then asked to complete a battery of questions regarding homeschooling and other leisure activities during the pandemic, referring to their youngest child in Grades 1-5, and regarding the period of January 15th-February 15th, 2021. Participants were asked to report the number of hours per week (from 0-60) attending school, being homeschooled by their parent (i.e., the panelist was asked about how many hours they spent homeschooling their child), learning at home, and engaging in specific leisure activities including being physically active, watching television, Netflix, movies, or YouTube, and playing video, computer, or app games. Information regarding the type of schooling (i.e., in-person; online; a mix of in-person and online; voluntary homeschooling) and the type of mandated homeschooling delivery by the school (i.e., live classes, pre-recorded classes, home learning packs) was also gathered. To examine reading behaviours, questions regarding the child's frequency of reading were assessed via number of hours spent per week reading for pleasure on both paper and screen modalities (0-60 hours/week). To assess internet access, participants were asked "To what extent did your child have access to a reliable internet connection?", referencing the studied period of January 15th-February 15th, 2021, which was assessed using a 7-point Likert scale. Participants were also asked how frequently they used four specific reading strategies with their children: sounding out words, discussing prior knowledge of the topic, checking in on understanding, and encouraging recapping. To select the four reading strategies included in the present study, published reports and guidelines on reading strategies were analyzed by the research team. The strategies of sounding out words, discussing prior knowledge of the topic, checking in on understanding, and encouraging recapping were the four most commonly recommended strategies across the guidelines analyzed. Strategy use was assessed for both paper reading and screen reading using a 7-point Likert scale, with *0 = never* and *6 = always*.

Data Analysis

Leisure activity was analysed using a Multivariable Analyses of Variance, MANOVA, so that both the child's schooling condition and the child's ages could be considered as independent variables, with age being categorized into two groups: early elementary, 5-7 years old, and middle elementary, 8-12 years old. Reading strategies were analysed using Mixed MANOVA, to examine the effect of reading modality and reading strategy type, while still looking at age and schooling condition as independent variables. All analyses were run in IMB SPSS Statistics, version 27.

RESULTS

Leisure Activities

Tables 3 and 4 summarize the descriptive statistics for all measures. There were between 0 and 10 extreme outliers within the leisure activities data ($z < \pm 3.29$)[34] and very few missing values (less than 1%). Overall, skewness and kurtosis values fell within the acceptable range (i.e., statistic ± 3.29)[34] for all 10 dependent variables. The overall dependent variable of time spent on leisure activities was analyzed using a 3 (schooling group: mandated, voluntary, in-person) X 2 [age: early elementary (5-7 years old), middle elementary (8-12 years old)] between-subjects multiple analysis of variance, MANOVA.

This analysis revealed a significant main effect of schooling group (Wilks $\lambda = .492$, $F = 40.25$, $p = .000$, $\eta^2 = .299$). Post-hoc testing indicated a statistically significant effect of schooling group on all dependent variables related to time spent on leisure activities (*p's <.05*), except for hours per week watching video entertainment ($p = .626$) (Table 7). As seen in Table 3, voluntary homeschoolers spent the most time learning at home not on a screen, interacting with friends or family on a screen, playing video, computer, or app games, being physically active, reading for pleasure on paper, and reading for pleasure on a screen relative to mandated homeschoolers and voluntary homeschoolers, with no difference between mandated homeschoolers and in-person learners. Voluntary homeschoolers also spent the most time interacting with friends and family in-person relative to mandated homeschoolers and in-person schoolers, with in-person schoolers spending more time on this activity than mandated homeschoolers. Both voluntary homeschoolers and mandated homeschoolers spent more time per week learning at home on a screen compared to in-person learners, with no difference between voluntary homeschoolers and mandated homeschoolers. In-person learners spent the most time per week attending school in person relative to voluntary homeschoolers and mandated homeschoolers, with voluntary homeschoolers spending more time attending school in-person than mandated homeschoolers.

A significant main effect of age was also found (Wilks $\lambda = .976$, $F = 2.347$, $p = .010$, $\eta^2 = .024$). Post-hoc testing revealed a significant effect of age on hours/week learning at home on a screen ($p = .029$) (Table 7). It was found that older children spent more hours per week learning on a screen compared to younger children. There was also a trend towards a significant difference for the main effect of age and time spent being physically active (Table 7), with younger children spending more hours per week being physically active compared to older children (Table 4). The analysis revealed a non-significant main effect for age and attending school in-person, learning at home on a screen, interacting with family and friends in-person, interacting with family and friends on a screen, watching video entertainment, playing video, computer, or app games, reading for pleasure on paper and reading for pleasure on a screen (p's > .05) (Table 7).

Table 4. *Means of leisure activities based on age (younger = ages 5-7 years; older = ages 8-12 years).*

Variable (hours/week)	**Younger** ***M(SD)***	**Older** ***M(SD)***
Attending school in-person	21.11 (16.88)	20.75 (16.21)
Learning at home (screen)	16.25 (15.32)	18.75 (15.74)
Learning at home (not screen)	12.67 (12.97)	13.34 (13.74)
Socializing (in-person)	11.48 (13.34)	11.31 (13.93)
Socializing (screen)	11.96 (14.07)	13.13 (14.04)
Watching video entertainment	18.48 (13.88)	18.83 (14.58)
Playing online games	13.94 (14.04)	15.52 (14.46)
Being physically active	18.41 (14.29)	16.40 (14.51)
Reading for pleasure on paper	11.97 (12.94)	12.69 (14.47)
Reading for pleasure on a screen	10.98 (13.58)	11.27 (14.11)

Table 3. *Means of leisure activity based on schooling group and both schooling group and age (younger = ages 5-7 years; older = ages 8-12 years).*

Variable (hours/week)	**In-Person Learners** *M(SD)*			**Mandated Homeschoolers** *M(SD)*			**Voluntary Homeschoolers** *M(SD)*		
	Younger	Older	Total	Younger	Older	Total	Younger	Older	Total
Attending school in-person	31.63 (13.32)	32.20 (11.22)	31.94 (12.20)	11.30 (15.34)	10.59 (14.75)	10.88 (15.00)	15.24 (13.25)	18.13 (13.89)	17.11 (13.71)
Learning at home (screen)	10.24 (14.59)	9.00 (14.04)	9.56 (14.29)	22.00 (15.21)	25.52 (13.64)	24.07 (14.38)	19.45 (12.37)	23.35 (13.73)	22.00 (13.38)
Learning at home (not screen)	9.79 (13.97)	9.00 (12.91)	9.33 (13.39)	11.93 (10.10)	12.75 (11.81)	12.42 (11.14)	19.67 (12.41)	19.92 (14.59)	19.84 (13.84)
Socializing (in-person)	12.27 (14.50)	9.82 (13.22)	10.92 (13.85)	8.00 (11.83)	8.45 (13.47)	8.25 (12.81)	15.38 (11.82)	16.87 (13.93)	16.35 (13.22)
Socializing (screen)	11.07 (14.43)	10.56 (13.55)	10.79 (13.94)	9.38 (12.75)	12.02 (13.33)	10.94 (13.14)	17.81 (13.82)	17.95 (14.41)	17.90 (14.18)
Watching video entertainment	18.50 (15.39)	17.89 (15.09)	18.17 (15.21)	17.77 (12.57)	19.57 (14.55)	18.84 (13.79)	19.56 (12.65)	19.16 (13.91)	19.30 (13.46)
Playing online games	13.44 (15.19)	13.12 (13.78)	13.28 (14.14)	12.51 (12.12)	15.85 (14.49)	14.49 (13.66)	17.22 (14.07)	18.27 (14.86)	17.90 (14.56)
Being physically active	19.51 (14.97)	15.58 (14.23)	17.36 (14.68)	15.73 (13.18)	14.22 (14.64)	14.84 (14.06)	20.40 (14.08)	20.20 (14.07)	20.27 (14.05)
Reading for pleasure on paper	11.86 (14.30)	10.89 (13.84)	11.33 (14.04)	9.59 (10.88)	10.62 (14.25)	10.20 (12.98)	15.95 (12.21)	17.66 (14.45)	17.06 (13.70)
Reading for pleasure on a screen	9.95 (14.74)	7.90 (13.17)	8.82 (13.92)	8.51 (10.99)	9.90 (13.63)	9.34 (12.63)	17.00 (13.21)	17.47 (14.02)	17.29 (13.71)

Reading Strategies

Tables 5 and 6 summarize the descriptive statistics for all measures. To ensure the data was normal, normality tests were conducted on the raw scores of the dependent variable. There were between 0 and 8 extreme outliers within the reading strategies data ($z < \pm 3.29$)[34], and very few missing values (less than 1%). Overall, skewness and kurtosis values fell within the acceptable range (i.e., statistic ± 3.29)[34] for all 8 dependent variables. Mauchly's test of sphericity was significant for the within-subjects effect of strategy ($p < .001$), but was not significant for the within-subjects effect of modality ($p > .05$), and the modality and strategy interaction ($p = .169$). The assumption of sphericity was therefore satisfied for the individual factor of modality, and the interaction of modality and strategy, but not for the individual factor of strategy. This research question was analyzed using a Mixed MANOVA, with schooling group and age as the between-subjects factors and reading strategy type and modality as the within-subjects factors.

This analysis revealed a significant main effect of strategy modality (Wilks $\lambda = .947$, F = 53.46, p = .000, $\eta^2 = .053$), and strategy type (Wilks $\lambda = .966$, F = 11.27, p = .000, $\eta^2 = .034$).

A significant multivariate interaction effect was found between strategy modality and schooling group (Wilks $\lambda = .977$, $F(2,955) = 11.27$, $p < .001$, $\eta^2 = .02$). Bonferroni pairwise comparisons revealed that when comparing the use of reading strategies between paper and screen modalities, it was found that both mandated homeschoolers and in-person learners employed reading strategies while reading on paper more frequently than while reading on a screen (Table 8). No difference was found between modalities for voluntary homeschoolers. Follow-up Mixed MANOVAs concluded that, for the paper modality, both in-person learners and mandated homeschoolers used reading strategies significantly more than voluntary homeschoolers, with no difference between in-person learners and mandated homeschoolers. When looking at the screen modality,

mandated homeschoolers employed digital reading strategies significantly more than both in-person learners and voluntary homeschoolers (Table 8). No difference was found between in-person learners and voluntary homeschoolers for the digital modality.

Regarding strategy type, a significant three-way interaction effect was found between strategy type, schooling group, and age (Wilks $\lambda = .995$, $F(6,2865) = 5.36$, $p < .001$, $\eta^2 = .01$). Follow-up Mixed MANOVAs revealed that, when looking at in-person learners, all four reading strategies were employed significantly more with younger children as compared to older children (Table 9). Mandated homeschoolers showed a significant difference based on age and strategy type only for the strategy of sounding out while reading, which was employed more often with younger children (Table 9). And, voluntary homeschoolers showed a significant difference based on age and strategy type for the strategy of recapping what's been read, employing this strategy more often with younger children (Table 9). When comparing schooling groups, a significant difference was found between in-person learners and voluntary homeschoolers within the younger age group, such that in-person learners engaged with all strategies more often with younger children than voluntary homeschoolers. A significant difference was also found between mandated homeschoolers and voluntary homeschoolers for both age groups. Mandated homeschoolers engaged in all reading strategies more frequently than voluntary homeschoolers, with both older and younger children. No significant difference based on age and strategy type was found between mandated homeschoolers and in-person learners.

Table 7. *Summary of MANOVA results for leisure activities based on schooling group, age, and both.*

Variable (hours/week)	MANOVA Factor	*F*-value	df	*p*-value	Partial Eta Squared
Attending school in-person	Schooling Group	221.61	2,960	<.001	.32
	Age	1.00	1,960	.317	.00
	Schooling Group and Age	1.16	2,960	.315	.00
Learning at home on a screen	Schooling Group	100.32	2,960	<.001	.17
	Age	4.79	1,960	.029	.01
	Schooling Group and Age	3.47	2,960	.031	.01
Learning at home not on a screen	Schooling Group	47.20	2,960	<.001	.09
	Age	0.01	1,960	.928	.00
	Schooling Group and Age	0.38	2,960	.682	.00
Interacting with friends/family in-person	Schooling Group	23.30	2,960	<.001	.05
	Age	0.03	1,960	.856	.00
	Schooling Group and Age	1.86	2,960	.156	.00
Interacting with friends/family on a screen	Schooling Group	22.74	2,960	<.001	.05
	Age	0.66	1,960	.417	.00
	Schooling Group and Age	1.22	2,960	.296	.00
Watching TV, Netflix, movies, YouTube	Schooling Group	0.47	2,960	.626	.00
	Age	0.08	1,960	.782	.00
	Schooling Group and Age	0.70	2,960	.497	.00
Playing video, computer, app games	Schooling Group	7.24	2,960	<.001	.02
	Age	2.04	1,960	.154	.00
	Schooling Group and Age	1.44	2,960	.238	.00
Being physically active	Schooling Group	9.20	2,960	<.001	.02
	Age	3.81	1,960	.051	.00
	Schooling Group and Age	1.34	2,960	.263	.00
Reading for pleasure on paper	Schooling Group	17.27	2,960	<.001	.04
	Age	0.41	1,960	.521	.00
	Schooling Group and Age	0.82	2,960	.440	.00
Reading for pleasure on a screen	Schooling Group	31.24	2,960	<.001	.06
	Age	0.00	1,960	.957	.00
	Schooling Group and Age	1.55	2,960	.213	.00

Table 5. *Means of reading strategies based on schooling group and both schooling group and age (younger = ages 5-7 years; older = ages 8-12 years).*

Variable	Modality	In-Person Learners *M(SD)*			Mandated Homeschoolers *M(SD)*			Voluntary Homeschoolers *M(SD)*		
		Younger	Older	Total	Younger	Older	Total	Younger	Older	Total
Sound out	Paper	4.71 (1.18)	3.95 (1.66)	4.29 (1.51)	4.48 (1.17)	3.96 (1.51)	4.17 (1.41)	3.64 (1.28)	3.77 (1.08)	3.72 (1.16)
	Screen	4.28 (1.47)	3.53 (1.85)	3.87 (1.73)	4.12 (1.36)	3.82 (1.51)	3.94 (1.46)	3.64 (1.41)	3.73 (1.20)	3.70 (1.28)
Discuss prior knowledge	Paper	4.33 (1.14)	3.85 (1.24)	4.07 (1.21)	4.11 (1.12)	4.06 (1.19)	4.08 (1.16)	3.71 (1.16)	3.59 (1.24)	3.63 (1.21)
	Screen	4.11 (1.30)	3.41 (1.61)	3.73 (1.52)	3.87 (1.29)	3.88 (1.29)	3.88 (1.29)	3.59 (1.10)	3.64 (1.12)	3.62 (1.11)
Check understanding	Paper	4.40 (1.19)	3.98 (1.37)	4.17 (1.31)	4.28 (1.08)	4.19 (1.25)	4.23 (1.18)	3.92 (1.21)	3.80 (1.18)	3.84 (1.19)
	Screen	4.10 (1.35)	3.48 (1.63)	3.76 (1.54)	4.00 (1.23)	3.97 (1.34)	3.98 (1.30)	3.92 (1.21)	3.81 (1.24)	3.85 (1.23)
Recap what they've read	Paper	4.22 (1.25)	3.91 (1.41)	4.05 (1.35)	4.19 (1.18)	4.17 (1.27)	4.18 (1.23)	4.09 (1.14)	3.78 (1.19)	3.89 (1.18)
	Screen	4.09 (1.35)	3.50 (1.67)	3.77 (1.56)	4.01 (1.29)	3.98 (1.39)	4.00 (1.35)	4.02 (1.27)	3.72 (1.17)	3.82 (1.22)
Average	Paper	4.42 (1.02)	3.93 (1.24)	4.15 (1.17)	4.27 (0.93)	4.10 (1.11)	4.16 (1.04)	3.84 (0.91)	3.73 (0.89)	3.77 (0.90)
	Screen	4.15 (1.22)	3.50 (1.56)	3.78 (1.45)	4.00 (1.14)	3.91 (1.23)	3.95 (1.20)	3.79 (0.98)	3.72 (0.91)	3.75 (0.93)

Table 6. *Means of reading strategies based on age (younger = ages 5-7 years; older = ages 8-12 years).*

Variable	Modality	Younger *M(SD)*	Older *M(SD)*
Sound out	Paper	4.40 (1.27)	3.90 (1.27)
	Screen	4.09 (1.44)	3.69 (1.57)
Discuss prior knowledge	Paper	4.12 (1.16)	3.85 (1.23)
	Screen	3.92 (1.27)	3.64 (1.39)
Check understanding	Paper	4.26 (1.17)	4.00 (1.28)
	Screen	4.03 (1.28)	3.74 (1.44)
Recap what they've read	Paper	4.18 (1.20)	3.97 (1.31)
	Screen	4.05 (1.31)	3.73 (1.46)
Average	Paper	4.24 (0.99)	3.93 (1.11)
	Screen	4.02 (1.15)	3.70 (1.30)

Table 8. *Estimated marginal means for reading strategy modality by schooling group.*

Schooling Group	Modality	Mean	Standard Error	Lower Bound (95% CI)	Upper Bound (95% CI)
In-Person Learners	Paper	4.15	.05	4.04	4.25
	Screen	3.78	.06	3.66	3.91
Mandated Homeschoolers	Paper	4.17	.06	4.05	4.28
	Screen	3.95	.07	3.81	4.08
Voluntary Homeschoolers	Paper	3.77	.07	3.64	3.91
	Screen	3.75	.08	3.59	3.91

Table 9. *Estimated marginal means for reading strategy type by schooling group and age (younger = ages 5-7 years; older = ages 8-12 years).*

Strategy	Schooling Group	Age	Mean	Standard Error	Lower Bound (95% CI)	Upper Bound (95% CI)
Sound out	In-person Learners	Younger	4.49	.10	4.30	4.69
		Older	3.74	.09	3.56	3.92
	Mandated Homeschoolers	Younger	4.30	.11	4.08	4.52
		Older	3.89	.09	3.72	4.06
	Voluntary Homeschoolers	Younger	3.64	.14	3.36	3.92
		Older	3.75	.11	3.54	3.96
Discuss prior knowledge	In-person Learners	Younger	4.22	.09	4.06	4.39
		Older	3.63	.08	3.48	3.78
	Mandated Homeschoolers	Younger	3.99	.10	3.80	4.18
		Older	3.97	.08	3.82	4.12
	Voluntary Homeschoolers	Younger	3.65	.12	3.41	3.89
		Older	3.61	.09	3.44	3.79
Check understanding	In-person Learners	Younger	4.25	.09	4.08	4.43
		Older	3.73	.08	3.57	3.89
	Mandated Homeschoolers	Younger	4.14	.10	3.96	4.33
		Older	4.08	.08	3.93	4.23
	Voluntary Homeschoolers	Younger	3.92	.13	3.67	4.17
		Older	3.81	.09	3.62	3.99
Recap what they've read	In-person Learners	Younger	4.16	.09	3.98	4.34
		Older	3.71	.08	3.54	3.87
	Mandated Homeschoolers	Younger	4.10	.10	3.90	4.30
		Older	4.08	.08	3.92	4.24
	Voluntary Homeschoolers	Younger	4.06	.13	3.80	4.32
		Older	3.75	.10	3.56	3.94

DISCUSSION

The present study aimed to examine the behaviours and reading practices of children learning in various settings because of pandemic-related containment measures that were implemented in early 2021. More specifically, leisure activities, reading on paper and on a screen, and the reading strategies used in both formats across three co-occurring schooling conditions: mandated homeschooling, in-person learning, and voluntary homeschooling. It was hypothesized that children in mandated homeschooling would engage in the most digital reading and utilize digital reading strategies most frequently.

Leisure Activity Findings

Contrary to our hypotheses, voluntary homeschoolers spent significantly more time per week reading on a screen and on paper than both mandated homeschoolers and in-person learners **(H1a)**. This finding contrasts with previous research indicating an increase in digital reading during pandemic-related restrictions.[10] While we predicted that those required to learn from home due to pandemic restrictions would follow a similar trend, it was instead voluntary homeschoolers, those who learned from home for reasons unrelated to the pandemic, who spent the most time reading at home.

Regarding other screen-based activities, voluntary homeschoolers spent significantly more time on almost all other screen-based activities (i.e., interacting with friends or family on a screen; playing video, computer, or app games), inconsistent with both our hypothesis **(H1a)** and prior research showing increased time spent on a screen during pandemic-related lockdowns.[9,15,8] One potential explanation is the flexibility in voluntary homeschoolers —less rigid learning schedules could make it easier to spend time on other leisure activities. For (**H1b)**, we hypothesized that older children would spend more time reading for pleasure both on a screen and on paper—and no significant differences were found here. This result contrasts previous research supporting the development of reading skills with age[19], by which we hypothesized that reading for pleasure would also increase with age. This discrepancy could stem from the wording of our survey question, which asked about reading for pleasure but did not differentiate between reading as part of educational activities and reading during free time. Future research could better analyze reading practices by asking about shared and independent reading as an educational activity, and shared and independent reading in a child's free time. Regarding **(H1c)**, significant age-related differences were only found for time spent learning on a screen, with older children engaging in this activity more than younger children. This finding is consistent with McArthur et al. (2021)'s study, which showed that screen time increases with age. It is also possible that older children had more online learning requirements from school (i.e., live classes, online assessments), which may explain this difference.

Reading Strategy Findings

Regarding reading strategies **(H2a)**, we hypothesized that parents of mandated homeschoolers would employ digital reading strategies and paper reading strategies more frequently than both parents of voluntary homeschoolers and parents of in-person learners. Regarding strategy type **(H2b)**, it was hypothesized that the type of strategy implemented by parents would not significantly differ based on schooling groups.

When comparing the use of strategies across various reading modalities, it was found that mandated homeschoolers employed more reading strategies while reading on a screen compared to the other schooling groups. This is consistent with Read et al. (2021) who found that children spent more time reading on a screen after COVID-19 containment measures. Our hypothesis was based on the assumption that if mandated homeschoolers were engaging in more screen reading, they would also be using more reading strategies in this format—this prediction was supported. However, there was no difference between mandated homeschoolers and in-person learners when reading on paper—these two groups implement paper reading strategies at a comparable frequency, which contrasts **(H2a)**. This could potentially be explained by emphasis being put on paper reading strategies to parents from schools and school boards—an advantage that voluntary homeschoolers may not have access to. For example, in Nova Scotia, the provincial government provided mandated homeschooling families with structured literacy activities and reading strategy guidance to support home learning.[35] Additionally, a significant difference was found between in-person learners and voluntary homeschoolers, in that voluntary homeschoolers used strategies on paper less frequently than both other schooling groups.

Due to the limited research surrounding the types of reading strategies being used by families in the pandemic, no differences were hypothesized between the schooling groups. However, we did observe notable differences in how reading strategies were being used by parents based on their child's schooling group. In-person learners used all analyzed strategies differently between age groups—using all four strategies more frequently with younger children compared to older children. This might be because in-person learners receive more direct support from educators, leading parents to feel that their children are adequately supported. As children progress in their reading development, they may require less direct assistance.[19] The only strategy that mandated homeschoolers used differently based on age was sounding out words, using it more frequently with younger children. For the strategy of recapping what's been read, voluntary homeschoolers used this strategy more with younger children. This could suggest that voluntary homeschoolers, along with mandated homeschoolers, may be compensating for the lack of formal reading instruction by maintaining the use of strategies as their children grow older. Mandated homeschoolers may show differential use of sounding out words based on age, because this strategy may be more commonly known and therefore more accessible to mandated homeschoolers who might want to supplement their children's home learning. Research on voluntary homeschoolers is limited, especially when considering the vast number of reasons why a family may choose to homeschool their children. Future research could examine the types of curricula, reasons for homeschooling, and schooling schedules of homeschooling families, to better understand how the pandemic may have impacted their children's learning. When comparing the schooling groups more specifically, a significant difference was found between in-person learners and voluntary homeschoolers when comparing schooling group and age, such that in-person learners were more likely to use all four strategies with younger children than voluntary homeschoolers (with no differences for older children). Moreover, when comparing mandated homeschoolers and voluntary homeschoolers, mandated homeschoolers were more likely to use all strategies more frequently, with both younger and older children, than voluntary homeschoolers. These differences in strategy use based on age could be related to children's shift away from "learning to read" to "reading to learn" as children get older.[19] Parents may reduce their strategy use with children who have surpassed the "learning to read" stage, presuming that strategies are less needed to support children's

reading once they are in elementary school. We do therefore see a difference in how each homeschooling group uses reading strategies based on the specific strategy type.

Limitations and Future Directions

Limitations are present in the described study. First, the study design limited participant recruitment based on internet access. This study was disseminated via an online platform, and as such those with low internet access (who may have experienced these shifts towards digital learning differently) were likely not able to access the questionnaire as easily as those with higher internet access. Limited internet access may be a result of rural geographical location where strong internet connection is not available, or a result of the cost in accessing rapid internet service, meaning that due to the internet dissemination of the study, the sample of participants may not have represented all geographical settings and socioeconomic statuses appropriately. Future research might include purposeful sampling, and a telephone or paper option, to better represent those with low internet access. This research also relied on retrospective reporting on the period of January 15th-February 15th, 2021. While this was done intentionally, to examine a specific period of pandemic conditions in North America, participants' report may have been subject to memory bias. As well, the nature of self-report research means that participants may have altered their responses due to social desirability bias. The research is also limited in its generalizability, because of a sample that was predominantly White, and of a high socio-economic status. The sample was also only North American, which was intentional to examine the various pandemic restrictions that co-occurred at the beginning of 2021 in North America, but this does limit the generalizability of the research. Within the North American sample, certain provinces were more heavily represented than others, which is of note because different provinces had varying lengths of mandated homeschooling. For example, the most common Canadian province represented in our sample was Ontario, and this province had the longest mandated homeschooling of all Canadian provinces.[36] Students in different provinces and states may have been impacted differently by mandated homeschooling, based on how long this mandated homeschooling requirement was in place. Future research might aim to better represent individuals of diverse ethnicity and income level, and examine participants in different geographical areas, to better reflect the global differences in pandemic containment measures.

Implications of the Findings

Despite its limitations, this research offers a valuable perspective into the leisure and reading practices of families with elementary-aged children in North America during early 2021. This research is valuable first and foremost to parents, to be able to better understand how the changes in the lives of children during the COVID-19 pandemic may have impacted day-to-day living. The findings about reading practices and reading strategies can help parents more specifically, to examine their own reading practices with their children. It was found that generally, reading strategies were used the most with younger children who were mandated homeschoolers during the studied period. This discrepancy in strategy use is important especially when considering that reading at this elementary school stage of life is critical.[19] Furthermore, research has found that using reading strategies is beneficial to students' reading comprehension even in the older group studied in the present study[24], so this research might help support continuing strategy use with older children. The present research also holds significance for educators; knowing how children are learning and spending their time during mandated homeschooling specifically can help educators better accommodate students once they return to in-person learning, and better address educational gaps that may have come because of the pandemic.[37,38] Parents and educators alike can use these findings to analyse the practices they use when engaging children with reading, and to help mitigate any pandemic-related changes in reading behaviours.

CONCLUSION

The COVID-19 global pandemic has caused many changes in the lives of children. The significant change of learning from home, and its regional variations, are an area of considerable interest for current and future research, to help educators and parents better understand how pandemic-related changes may have impacted children. The present study has exposed variations in leisure activity and reading strategy use for families whose children are learning in-person, through mandated homeschooling, and through voluntary homeschoolers during the COVID-19 pandemic.

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