

## CLINICAL RESEARCH ARTICLE



# School-based health care: improving academic outcomes for inner-city children—a prospective cohort quasi-experimental study

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**BACKGROUND:** We examined whether a school-based health center model improved academic achievement compared to usual care.

**METHODS:** This was a quasi-experimental prospective cohort study. The primary outcome was an academic achievement. In addition, we analyzed sociodemographic characteristics and their relationship to academic achievement, and the wait time for a developmental assessment.

**RESULTS:** The differences in change of grades over time (from 2016/2017 to 2018/2019) were small for reading (−0.83, 95% CI −3.48, 1.82,  $p = 0.51$ ), writing (−1.11, 95% CI −3.25, 1.03,  $p = 0.28$ ), and math (0.06, 95% CI −3.08, 2.94,  $p = 0.98$ ). The experimental arm's average wait time for developmental assessment was 3.4 months.

**CONCLUSION:** In this small, quasi-experimental prospective cohort study, we did not find evidence that our SBHC model improved academic achievement; however, the wait time at the SBHCs was considerably less than the provincial wait time for a developmental assessment.

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## IMPACT:

- This study describes a unique and innovative school-based health center model.
- Our findings support the benefits of school-based health centers in diagnosing and treating children with developmental and mental health disorders for disadvantaged communities.
- This study did not find an improvement in academic achievement for school-based health center users.
- This study found that the wait time to developmental assessment was shorter for school-based health center users compared to the wait time reported in the community.
- Pandemic-associated school disruptions have highlighted the importance of accessible school-based health services for children requiring mental health and developmental assessments and care.

## INTRODUCTION

Children from low-income families and racialized communities often experience difficulties accessing health care and are less likely to receive early interventions.<sup>1,2</sup> Care through school-based health centers (SBHCs) aims to reduce access barriers and increase collaboration amongst educators and health care providers.<sup>3,4</sup> There are approximately 40 SBHCs in Canada and over 2000 in the United States (US). Most SBHCs in Canada and the US serve a high proportion of students with social and economic disadvantages.<sup>5,6</sup> Eighty-five percent of SBHCs in the US are staffed by nurse practitioners, 40% by physicians, and 65% include behavioral health staff as part of their teams. Forty-one percent of SBHCs have other allied health care providers

(e.g., dentists, vision specialists, nutritionists, and dietitians) in addition to primary care and behavioral health staff.<sup>7</sup> Studies from the US have found SBHCs improve health status, vaccination rates, health-related quality of life, hospitalization rates, and morbidity among children.<sup>1,8–13</sup> US quasi-experimental and observational studies have also demonstrated better academic performance, school attendance, and school connectedness for SBHC users compared to nonusers.<sup>1,8–11,13–15</sup> However, these studies primarily focused on high school students with an average age of 15.2 years old.<sup>16</sup>

The Model Schools Pediatric Health Initiative is the largest school-based health care program in Ontario. The initiative was established in 2010 as a partnership between St. Michael's

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Hospital and the Toronto District School Board (TDSB), Canada's largest public school board, to reduce barriers to health care access for underserved and disadvantaged children.<sup>4,17</sup> The Initiative was formed with a memorandum of understanding outlining the program as a mutually beneficial and supportive arrangement between institutions to provide health services for students to support student success. Initially, the program was designed with one SBHC serving a cluster of surrounding at-risk elementary schools. The TDSB selected the elementary schools based on two criteria: (1) the school was designated as a "model school" (a model school is one of 150 schools as determined by the TDSB's learning opportunities index which ranks TDSB schools based on measures of external challenges affecting student success<sup>18</sup> and (2) school location was in the same general area as the SBHC. The initiative has since expanded to include three SBHCs run by Unity Health Toronto (two SBHCs affiliated with St. Michael's Hospital and one SBHC affiliated with St. Joseph's Health Centre) serving 70 at-risk schools.

The SBHCs are staffed by family physicians, pediatricians, neurodevelopmental pediatricians, a therapist, and a patient navigator. In contrast to SBHCs in other parts of Canada and the US, our SBHC model consists of a physician-led team with subspecialty pediatric care, as well as a patient navigator, and therapist on-site.<sup>6,7</sup> This staffing model allows for diagnostic developmental assessments in addition to supporting the developmental and mental health needs of our patients. The patient navigator compliments the physician's work by supporting families in accessing community services and funding. The therapist provides counseling and family support.

Students attend the SBHCs with their guardians and are referred by teachers, other school staff, parents, or the School Support Team (SST). The SST is a school-based, interdisciplinary team involving school board psychologists, social workers, teachers, principals, and other school board staff who meet monthly at all TDSB schools as standard of care.<sup>19</sup> The team's role is to discuss students who are experiencing developmental, mental health, and academic difficulties, and to develop a plan to support them. A frequent recommendation of the SST is for the student to be assessed by a physician for health or developmental factors which may contribute to their school difficulties. There are many access barriers and long wait times to see physicians; especially pediatricians and pediatric sub-specialists in the community. Therefore, one of the unique aspects of our SBHC model is that physicians join SST meetings at some participating schools to help identify which students require a physician assessment, and then facilitate a referral to the partnering SBHCs. This SBHC model is feasible and decreases health care access barriers for students from low-income neighborhoods with mental health and/or developmental concerns.<sup>4</sup> We believe this model is reproducible with the cooperation of local school boards and health care providers. Please see Fig. 1 for details regarding the Model Schools Pediatric Health Initiative model.

The present quasi-experimental prospective cohort study followed the above-described SBHC program and included 20 TDSB elementary schools without previous exposure to the Model Schools Pediatric Health Initiative. Our primary objective was to examine if this SBHC model impacted academic achievement (i.e., grades and standardized test scores). The secondary objectives were to examine students' sociodemographic characteristics and their relationship to academic achievement and wait time to physician assessment at the SBHCs.

## METHOD

This was a quasi-experimental prospective cohort study of 20 TDSB elementary schools, with follow-up of 14 schools. Student recruitment was planned for the 2017/2018 and 2018/2019 academic years. However, recruitment did not occur in 2018/2019 due to school closures caused by

teacher strikes in 2019/2020. This study was reported using the STROBE statement.<sup>20</sup>

## Design and interventions

**St. Michael's Hospital catchment.** The study was originally planned as a randomized cluster trial of 16 schools allocated to the experimental and control arm in a 1:1 ratio. However, at the time of study initiation, the Model Schools Pediatric Health Initiative was already established in the St. Michael's Hospital catchment area; therefore, the TDSB did not assent to have schools randomized that were intended to become part of the Model Schools Pediatric Health Initiative. Consequently, the TDSB provided six schools intended to become part of the initiative that were eligible for the experimental arm. They also provided eight schools not originally prioritized for the initiative with comparable socioeconomic student characteristics that were eligible for the control arm.

Four of the six schools provided by the TDSB for the experimental arm were randomly selected for the study. Of the eight schools that were provided for the control arm, four were randomly selected. One experimental school and two control schools declined after random selection; one additional experimental school and two control schools were subsequently identified by the TDSB and directly included without random selection. Therefore, four schools were analyzed from each arm (Fig. 2, left).

**St. Joseph's Health Centre catchment.** The TDSB provided eight schools with similar socioeconomic characteristics which were randomly allocated to the experimental and control arms in a 1:1 ratio. One experimental school was unavailable for follow-up and two control schools declined after randomization; one additional school was identified by the TDSB and directly included in the control arm after randomization. Therefore, in the St. Joseph's Health Centre catchment, three schools were analyzed from each arm (Fig. 2, right).

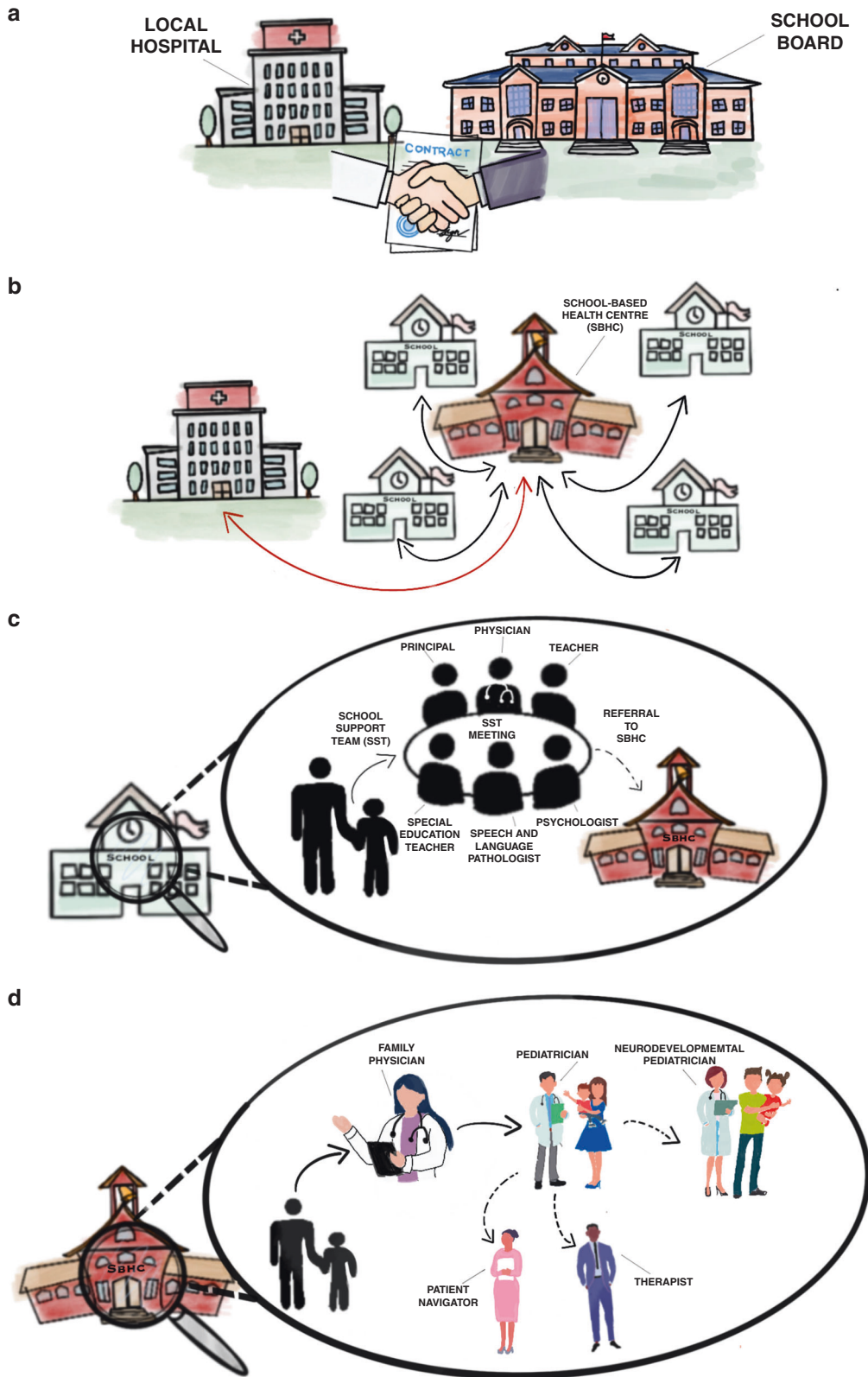
All schools involved in the study had no prior exposure to SBHC services. Recruitment of schools started in 2016 and closed in 2017. Students were included in the analysis if they presented to a SST meeting at study schools in 2017/2018 and were identified to require physician assessment. As per the Model Schools Pediatric Health Initiative procedures, in the experimental arm, physicians attended monthly SST meetings to help identify which students required physician assessment. Students were then offered physician assessments and follow-up care through the participating SBHCs (Fig. 1). Control schools received standard of care; physicians did not attend monthly SST meetings and students identified to require physician assessment were advised to obtain the assessment in their communities, as students did not have access to the SBHCs. To decrease the potential for bias, physicians who attended SST meetings in the experimental arm did not assess students at the SBHCs and did not attend meetings or assess students in the control arm.

## Outcomes

The primary outcome was academic achievement which included report card grades and standardized test scores in the 2017/2018 and 2018/2019 academic years. Due to school closures during teacher strikes and the COVID-19 pandemic, we were unable to obtain report card grades or standardized test scores from the 2019/2020 academic year. Furthermore, there were insufficient standardized test results obtained in 2017/2018 to conduct the planned analysis, hence the standardized test scores could not be analyzed. In addition, we analyzed sociodemographic characteristics and their relationship to academic achievement, and the wait time between a student's SST date and first SBHC visit in experimental schools. Since the collection of grades was de-identified, they could not be associated with students' sociodemographic characteristics.

## Data sources

For the purpose of this study, the TDSB provided de-identified standardized test scores,<sup>21,22</sup> report card grades (i.e., reading, writing, and math), and demographic data for children requiring physician assessment at SST meetings from both study arms. They also provided school-level demographic data. Ontario's grade conversion chart was used to convert letter grades to percentages.<sup>23</sup> SBHC medical records were reviewed to determine which students were referred from SST meetings during the 2017/2018 academic year from the seven experimental schools.

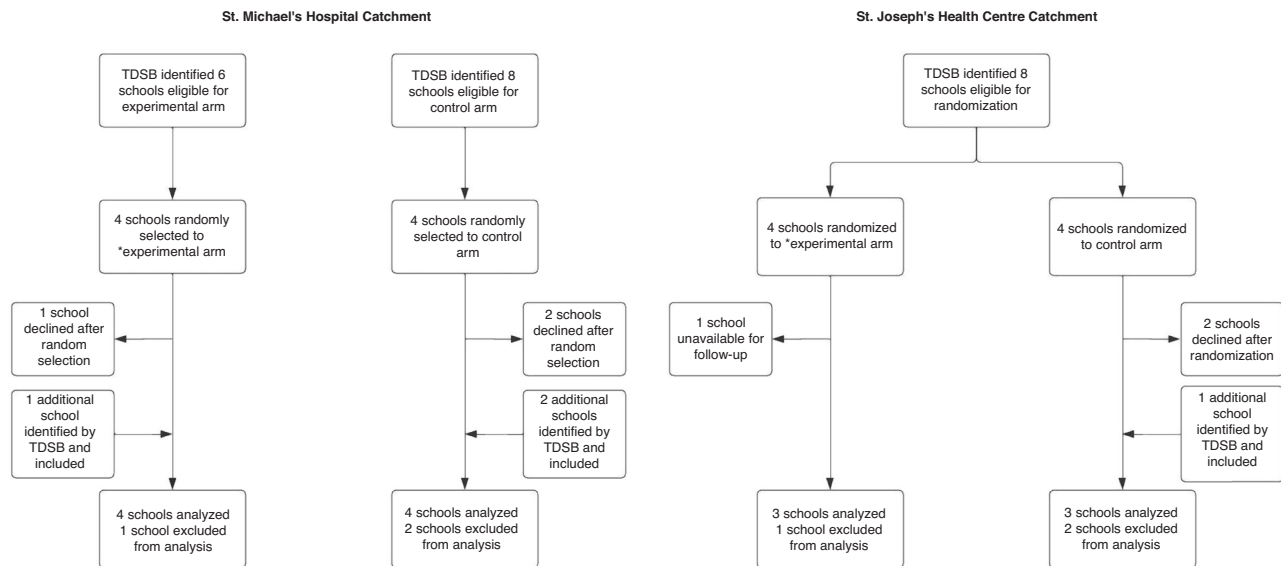


**Fig. 1 The Model Schools Pediatric Health Initiative Program. a** A partnership between the local hospital and the local school board. **b** Schools accessing the SBHC and the flow of communication. **c** The SBHC referral pathway. **d** The SBHC appointment flow.

Retrospective medical record review of the identified records was conducted to determine diagnoses, management, and wait time from SST meeting to the first SBHC visit.

**Statistical analysis**

The school board only assented to include 16 schools (8 in each arm); therefore, a formal power calculation was not completed. We estimated



**Fig. 2 School selection flow diagram.** The left panel describes the process by which schools were selected from the St. Michael's Hospital catchment. The right panel describes the process by which schools were selected from the St. Joseph's Health Centre catchment.

**Table 1.** School-level characteristics.

Characteristic	Experimental arm (N = 7 schools, 2091 students)	Control arm (N = 7 schools, 2425 students)	p value
Students enrolled per school (2017/2018), median (IQR), n	334 (244, 339)	268 (185, 367)	1.00
Students living in low-income households, median (IQR), %	32.8 (21.6, 40.0)	36.8 (26.2, 38.2)	0.44
Students with parents who do not have a certificate, diploma, or degree, median (IQR), %	14.0 (9.7, 16.5)	11.2 (8.6, 18.4)	1.00
Students receiving special education services, median (IQR), %	15.0 (12.9, 18.6)	15.7 (12.4, 18.5)	0.90
First language is not English, median (IQR), %	23.3 (17.4, 45.5)	44.2 (33.7, 47.0)	0.32
New to Canada from a non-English speaking country, median (IQR), %	5.5 (4.7, 9.9)	12.0 (5.7, 20.1)	0.34
Students seen at SST meetings (2017/2018) per school, median (IQR) <sup>a</sup> , n	30 (27, 40)	31 (26, 40)	1.00
Students identified per school to require physician assessment at SST meetings, median (IQR) <sup>a</sup> , %	40.9 (27.5, 83.3)	15.4 (10.0, 19.4)	0.055

All p values are two-sided.

IQR interquartile range.

<sup>a</sup>Number of students seen at SST meetings and number identified to require physician assessment at SST meetings was provided for five schools in each arm.

two students would be identified to require physician assessment at SST meetings each month.

The Wilcoxon rank sum test was used to compare school and student baseline characteristics. For the primary analysis, report card grades were treated as continuous repeated measures and analyzed using a linear mixed-effect model. The schools and students were the random effects, the group assigned was the fixed effect, the grades were time-dependent (hence treated as an interaction variable) and the baseline grades were included as a covariate. Differences between experimental and control schools with 95% confidence intervals were estimated at the observed average time since SST meeting. In this analysis, the baseline was defined as the grade most proximal and prior to their SST date. Wait time for the intervention arm was described using the mean and standard deviation. All analyses were conducted in R<sup>24</sup> (version 4.0.2) using the packages lme4, broom, ggplot2 and/or aod.

## RESULTS

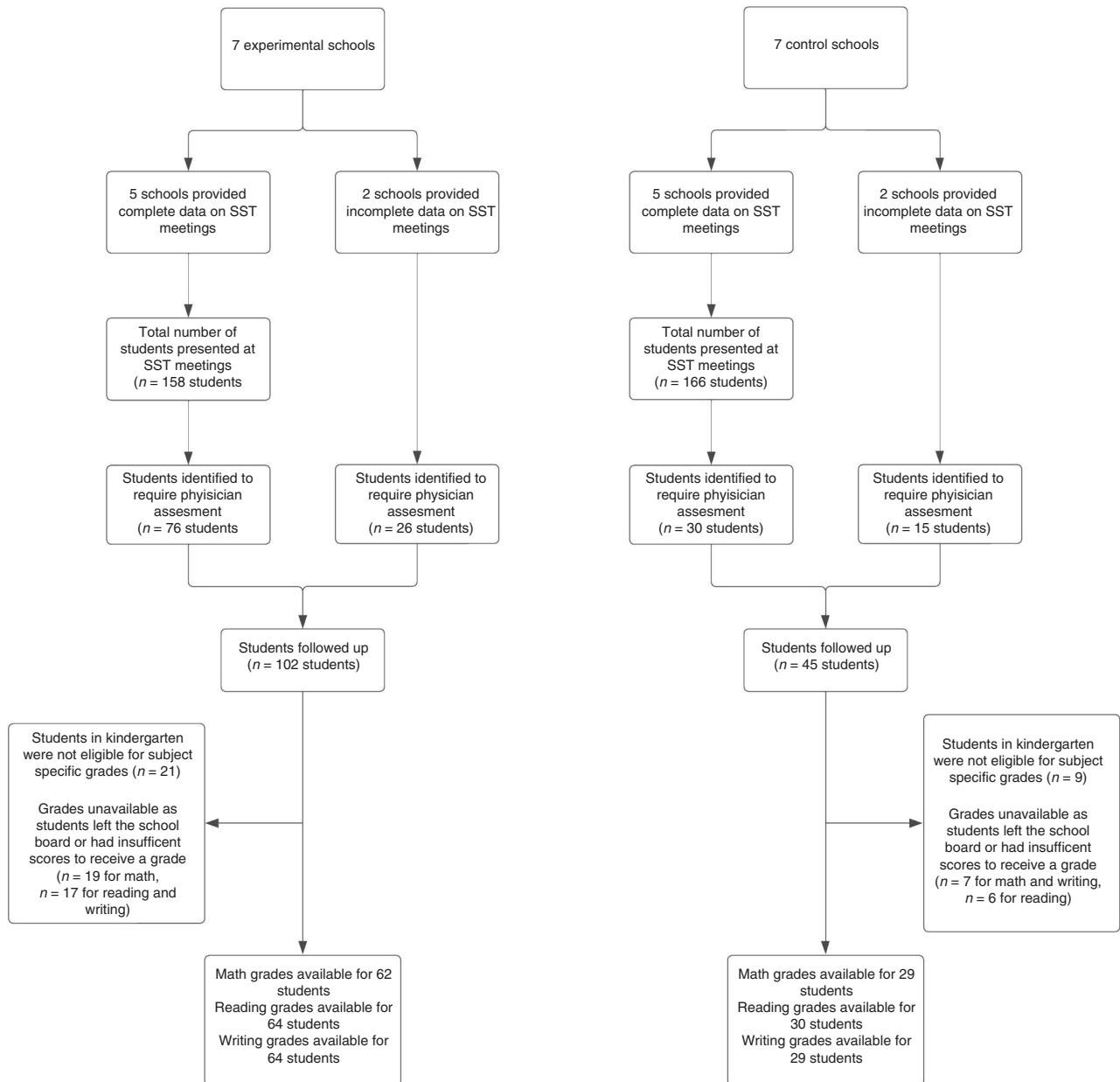
### Sample characteristics

Twenty elementary schools were included in this study, with follow-up and analysis of students from 14 schools. School-level

demographics for these 14 schools are described in Table 1. Figure 3 shows a flowchart of students identified to require physician assessment at SST meetings. In the experimental arm, 102 students from seven schools were identified to require physician assessment at SST meetings. In the control arm, 45 students from seven schools were identified to require physician assessment at SST meetings and advised to pursue this in the community. Table 2 shows the characteristics of students identified to require physician assessment at SST meetings.

### Detailed characteristics of experimental arm

Of the 102 students identified to require physician assessment in the experimental arm, SBHC medical record review identified 33 students who attended the SBHCs. The average age of SBHC users at their SST meeting was 6.6 years. Of the 33 SBHC users, 5 (15%) did not speak English as their first language, and 7 (21%) were from a family with an annual income of <\$30,000.00. Of the 33 children who attended the SBHCs, 9 (27%) were diagnosed with attention-deficit/hyperactivity disorder, and 5 (15%) with autism



**Fig. 3** Flow diagram of students included in the study. The left panel outlines the process by which students identified to require physician assessment at SST meetings were included in the experimental arm. The right panel outlines the process by which students identified to require physician assessment at SST meetings were included in the control arm.

spectrum disorder. Detailed demographic characteristics of students who attended the SBHCs are presented in Table 3. Table 4 includes detailed diagnoses of students who attended the SBHCs.

### Between-group comparisons

The differences in change over time (from 2016/2017 to 2018/2019) were small for reading ( $-0.83$ , 95% CI  $-3.48, 1.82$ ,  $p = 0.51$ ), writing ( $-1.11$ , 95% CI  $-3.25, 1.03$ ,  $p = 0.28$ ), and math grades ( $0.06$ , 95% CI  $-3.08, 2.94$ ,  $p = 0.98$ ; Table 5). The mean wait time between a child's SST meeting and their first SBHC visit was 3.4 months (SD, 6.6 months, range of 0–35 months).

### DISCUSSION

In this quasi-experimental prospective cohort study of 20 schools with a follow-up of 14 schools, we found no differences in report

card grades over time among students from schools with physicians attending SST meetings and with access to SBHCs, compared to students from control schools without physicians at SST meetings and without access to SBHCs. Almost one-quarter of students who attended the SBHCs from the experimental arm were from families living in poverty with an annual family income  $< \$30,000$ , and almost 40% were from single-parent households. The average wait time between a student's SST meeting and their first SBHC visit in the experimental arm was 3.4 months. This is considerably shorter than the wait time for a developmental assessment in Ontario which may be more than 1 year.<sup>25</sup>

Twice as many students were identified to require physician assessment in the experimental arm compared to the control arm. Furthermore, many students identified at SST meetings in the experimental arm were referred to the SBHCs and received a developmental or mental health diagnosis, as well as management



**Table 2.** Characteristics of students identified at SST meetings to require physician assessment.

Characteristic	Experimental arm (N = 7 schools, 102 children identified)	Control arm (N = 7 schools, 45 children identified)	p value
Students identified per school to require physician assessment at SST meetings, median (IQR), n	16 (10, 18)	5 (4, 8)	0.02
Born in Canada, median (IQR), %	88.2 (80.6, 96.9)	80.0 (75.0, 95.83)	0.70
Male, median (IQR), %	72.0 (66.7, 75.2)	75.0 (62.5, 77.5)	1.00
Female, median (IQR), %	28.0 (24.8, 27.4)	25.0 (22.5, 37.5)	1.00
Mother tongue English, median (IQR), %	50.0 (34.3, 76.4)	50.0 (45.0, 79.2)	0.75
Mother tongue non-English, median (IQR), %	50.0 (23.6, 65.7)	50.0 (20.8, 55.0)	0.75
Individual Education Plan (IEP), median (IQR), %	58.8 (53.8, 67.7)	60.0 (50.0, 83.3)	1.00
Identification, Placement, and Review Committee (IPRC) designation, median (IQR), %	11.1 (6.9, 20.8)	0.0 (0, 16.7)	0.32

All *p* values are two-sided.

IQR interquartile range.

**Table 3.** Characteristics of students in the experimental arm who attended the SBHCs<sup>a</sup>.

Characteristic	N = 33	%
Home arrangement		
Single-parent household	13	39.3
Two-parent household	10	30.3
Other	2	6.1
Parent 1 born in Canada	10	30.3
Parent 2 born in Canada	4	12.1
Child born in Canada	20	60.6
Child uses English as a first language	22	66.7
Annual family income		
<30,000	7	21.2
30,000–49,999	4	12.1
50,000–74,999	1	3.0
75,000–99,999	1	3.0
>100,000	3	9.1
Ethnicity		
North American	6	18.2
Mixed background	4	12.1
Latin American	4	12.1
East Asian	4	12.1
Caribbean	3	9.1
African	3	9.1
South Asian	1	3.0

<sup>a</sup>From SBHC chart review.

of their condition. Since the Model Schools Pediatric Health Initiative reduces health care access barriers, these students may not have been diagnosed and treated outside of this initiative.

To our knowledge, this is the first quasi-experimental study to assess the role of SBHCs on elementary school students' academic achievement in North America. Like the Model Schools Pediatric Health Initiative, SBHCs in the US are predominantly located in low-income neighborhoods and serve minority students with developmental and/or mental health concerns<sup>26–28</sup> In California, SBHCs are located in schools where 75% of students enrolled have a family income that is at or below 130% of the federal poverty threshold.<sup>29</sup> Similarly, our study showed that 33% of students seen

**Table 4.** Diagnoses, referrals, and medications for students in the experimental arm who attended the SBHCs<sup>a</sup>.

Characteristic	N = 33	%
Diagnosis <sup>b</sup>		
Learning disability	10	30.3
Attention/deficit-hyperactivity disorder	9	27.3
Autism spectrum disorder	5	15.2
Developmental delay	5	15.2
Other behavioral problems	4	12.1
Oppositional defiant disorder	4	12.1
Referral to SBHC patient navigator <sup>b</sup>	11	33.3
Referral to SBHC therapist <sup>b</sup>	8	24.2
Referrals to providers outside the SBHC <sup>b</sup>		
Hearing test	18	54.6
Psychological testing	15	45.4
Vision test	13	39.4
Community mental health agency	12	36.4
Speech and language pathologist	7	21.2
Occupational therapist	6	18.2
Nutritionist/dietician	3	9.1
Otolaryngologist	3	9.1
Psychiatrist	2	6.1
Physiotherapist	1	3.0
Other clinicians	3	9.1
Medication prescription <sup>b</sup>	12	36.4
Medication type <sup>b</sup>		
Psychotropic medications	10	83.3
Non-psychotropic medications	9	75.0

All *p* values are two-sided.

<sup>a</sup>From SBHC chart review.

<sup>b</sup>Patients may have more than one diagnosis/treatment.

at the SBHCs through an SST referral were from a low-income home (family annual income <\$50,000).<sup>30</sup> Another US study showed that schools with access to SBHCs had higher percentages of Black and Hispanic students enrolled compared to those without access to SBHCs.<sup>7</sup> Similarly, more than half of the students referred to SBHCs in our study were racialized. By strategically placing SBHCs in disadvantaged neighborhoods, children from

**Table 5.** Linear mixed-effect model analysis and hypothesis testing results.

	Experimental		Control		Difference (95% CI)	p value
	Students	Grade	Students	Grade		
Reading grade	62	67.7%	29	68.5%	-0.8% (-3.48 to 1.82)	0.51
Writing grade	64	65.5%	30	66.6%	-1.1% (-3.25 to 1.03)	0.28
Math grade	64	69.1%	29	69.0%	0.1% (-3.08 to 2.94)	0.98

The difference in grade was estimated at approximately 200 days since SST meeting date.

low-income households and minority populations can better access diagnoses and treatments for mental health and developmental concerns.<sup>7,23</sup> Similar to SBHCs in the US, our SBHC model reduced wait time for developmental and mental health care.<sup>8,31</sup> Earlier access to health care not only allows children to receive necessary interventions sooner, but also brings feelings of relief to both the child and their caregivers.<sup>32–34</sup>

This study has several limitations. First, we did not have sufficient standardized test scores to include in our primary analysis due to the intervals at which these tests were administered, and school closures due to elementary school teacher strikes and the COVID-19 pandemic. Therefore, only grades could be analyzed. Second, the follow-up time to collect grades was limited due to school closures. Third, we were unable to link students' demographic data to their grades to test for associations, since grades were provided de-identified. Fourth, wait time data was not available for the control group for comparison. Fifth, our sample size was smaller than anticipated since school closures prevented recruitment in the second year of the study, and some schools were unavailable for follow-up or declined after random selection and randomization (Fig. 2). Sixth, fewer students were identified to require physician assessment at SST meetings in the control arm as compared with the experimental arm. The comparison of their grades was therefore difficult to interpret. Finally, this study included two urban settings and findings may not be generalizable to other settings.

Research on the influence of SBHCs on academic achievement is sparse but studies have shown a positive association between SBHC usage and student grades in the US.<sup>8,9,14,15,35</sup> Many of these studies focused on high school students and/or were quasi-experimental with long follow-up periods (e.g., 2–3 years). A 2-year study found that students who used SBHC mental health services had improvements in their grades compared to nonusers.<sup>15</sup> However, another longitudinal study with 3–10-year follow-up reported no association between the presence of SBHCs in schools and students' grades.<sup>36</sup> However, that study included all students enrolled at schools with SBHCs regardless of whether or not they attended the SBHCs making it more difficult to show the direct impact of SBHCs on student achievement. While our study found no differences between SBHC users' and nonusers' report card grades over time, we had a relatively short follow-up period with a range of 1–21 months (mean 15 [standard deviation 4] months)), and therefore were less likely to show an improvement in grades which were influenced by a variety of direct and indirect factors.

## CONCLUSION

This study describes a unique and innovative SBHC model. While we did not find evidence in our quasi-experimental prospective cohort study for improved short-term academic achievement, the wait time at the SBHCs was considerably less than the provincial wait time for a developmental assessment. Furthermore, there were twice as many students identified to require physician assessment at SST meetings in the experimental arm. Pandemic-associated school disruptions have highlighted the importance of

accessible school-based health services for children requiring a health and developmental assessment.<sup>37,38</sup> Our findings support the benefits of SBHCs in diagnosing and treating children with developmental and mental health disorders for disadvantaged communities. Additional studies could explore other relevant outcomes including school attendance. A future, adequately powered randomized trial with a longer follow-up may be needed to better understand the impact of our SBHC model on academic achievement.

## DATA AVAILABILITY

School-level demographic data in Table 1 are publicly available online via the TDSB website and upon request. Student-level data provided by the TDSB within certain data-sharing agreements are solely for permitted usage at St. Michael's Hospital, Unity Health Toronto. All patient health information and demographics are stored securely and held in de-identified form. The data-sharing agreement restricts the authors from making SBHC patient data publicly available. Source data specific to this study may be reviewed at Unity Health Toronto if necessary, with the approval of the TDSB and the required ethics review bodies.

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## AUTHOR CONTRIBUTIONS

Each author contributed to the development of the design of this study, the data collection process, analysis, and the preparation of this manuscript. S.R.: significant contributions to data collection, analysis, and interpretation; drafting the manuscript, critically editing the manuscript for key intellectual content; and approving the final version to be published. P.J.: significant contributions to design, and interpretation; data analysis, and interpretation; drafting the manuscript, critically editing the manuscript for key intellectual content; and approving the final version to be published. M.D.S.: significant contributions to design, data collection, analysis, and interpretation; drafting the manuscript, critically editing the manuscript for key intellectual content; and approving the final version to be published. K.E.T.: significant contributions to design, data collection, analysis, and interpretation; drafting the manuscript, critically editing the manuscript for key intellectual content; and approving the final version to be published. J.M.: significant contributions to design, and interpretation; drafting the manuscript, critically editing the manuscript for key intellectual content; and approving the final version to be published. S.F.: significant contributions to design, data collection, and interpretation; drafting the manuscript, critically editing the manuscript for key intellectual content; and approving the final version to be published.

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## COMPETING INTERESTS

The authors declare no competing interests.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Parental consent was provided for retrospective medical record review. TDSB internal research staff identified which students were presented at SST meetings and required a physician assessment during the study period. TDSB data for these students (including grades) provided de-identified to the research team. Institutional research ethics board approval was received from Unity Health Toronto and the TDSB. Even though the study did not assess health outcomes, it was registered with ClinicalTrials.gov (NCT04540003).

## ADDITIONAL INFORMATION

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