

RESEARCH ARTICLE

# School Sports Opportunities Influence Physical Activity in Secondary School and Beyond

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## ABSTRACT

**BACKGROUND:** The purpose of the present study was to examine whether the availability of intramural or extramural sports in secondary schools is associated with physical activity levels in youth throughout secondary schools and at age 20.

**METHODS:** Eight hundred and eight adolescents from 10 secondary schools in Montreal, Canada, provided physical activity data every 3 months during the school year from ages 13 to 17, and again at age 20. School administrators completed questionnaires on the availability of intramural and extramural sports. Three-level general linear models were used to examine associations among the number of intramural and extramural sports, moderate and vigorous physical activity controlling for age, sex, body mass index, mother's education, and school-level socioeconomic status.

**RESULTS:** Regardless of whether or not they reported participating in intramural sports, adolescents in schools with more intramural sports engaged in 3.6 ( $p = .03$ ) more total, and 1.3 ( $p = 0.03$ ) more vigorous activities per week than those attending schools with fewer intramural sports. Number of extramural sports was not statistically significantly associated with physical activity, regardless of whether or not individual students participated.

**CONCLUSION:** Providing more opportunities for intramural sports in secondary schools may be an effective strategy to help adolescents attain physical activity recommendations.

**Keywords:** physical activity; physical education; exercise; intramural sports; extramural sports.

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Physical activity (PA) is critical for healthy growth and development during childhood and adolescence,<sup>1,2</sup> and numerous reports suggest that low levels of PA in youth contribute to the development of chronic disease later in life.<sup>1-3</sup> Current guidelines suggest that youth should accumulate 60 minutes or more of PA daily in physical activities of moderate and/or vigorous intensity.<sup>2</sup> In 2008, it was estimated that 87% of Canadian youth aged 12-18 did not accumulate enough PA daily to meet international guidelines.<sup>4</sup> Compounding the problem, moderate and vigorous PA decline dramatically during and after secondary school, when young people transition to university or the job market.<sup>5,6</sup>

Schools are an ideal place to promote PA in youth because they can provide widespread access to opportunities for youth to be physically active.<sup>1,7</sup> Beyond the physical education curriculum, extracurricular activities including intramural and extramural sports may increase PA levels in youth.<sup>8</sup> Intramural sports provide opportunities for students with a wide range of abilities to participate in competitive and noncompetitive PA within their own schools.<sup>8-10</sup> Extramural sports are competitive, involve selection of skilled athletes, and involve competition between schools.<sup>8-10</sup> The US Centers for Disease Control (CDC) suggests that intramural sports opportunities help students learn to integrate PA into their daily routines.<sup>11</sup> However,

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1 in 2006, intramural sports were available in only 45%  
2 of secondary schools in the United States, while 91%  
3 of schools offered extramural sports.<sup>12,13</sup> In Canada in  
4 2006, intramural and extramural sports were offered  
5 in 83% and 80% of secondary schools, respectively.<sup>14</sup>  
6 Extracurricular PA programs at school have been com-  
7 pletely eliminated in some jurisdictions because of lack  
8 of priority and budget constraints.<sup>12,13</sup>

9 Multicomponent school-based PA interventions  
10 that include intramural and extramural sports oppor-  
11 tunities are effective in increasing PA levels in youth in  
12 the short term.<sup>2,15,16</sup> However, most studies that exam-  
13 ine the association among intramural and extramural  
14 sports and PA levels in youth involve multicompo-  
15 nent interventions that do not distinguish the effect  
16 of the individual components of the intervention; in  
17 addition, these studies have follow-up periods of fewer  
18 than 6 months.<sup>16</sup> Although the CDC recommends that  
19 schools offer intramural sports opportunities, there is  
20 little empirical evidence that intramural or extramural  
21 sports opportunities at school are associated with PA  
22 levels in youth.<sup>17</sup> Examining the association among  
23 intramural and extramural sports programs and PA  
24 may help provide an evidence base to inform school  
25 policy.<sup>18</sup> The purpose of the present study was to  
26 examine if the availability of intramural and extramu-  
27 ral sports in secondary school is associated with total,  
28 moderate, or vigorous PA levels in youth throughout  
29 high school and beyond (ie, as young adults).

## 31 METHODS

### 33 Subjects

34 A total of 1293 participants were recruited in  
35 1999-2000 in a convenience sample of 10 Montreal-  
36 area secondary schools. A detailed description of the  
37 study methods has been published.<sup>19</sup> Schools were  
38 selected in consultation with local boards and school  
39 principals to include a mix of French and English  
40 schools, urban, suburban, and rural areas, and high  
41 and low socioeconomic neighborhoods. Baseline data  
42 were collected in classroom-administered self-report  
43 questionnaires, when participants, aged 12-13 years,  
44 were in their first year of secondary school. Follow-up  
45 data were collected every 3 months during the 10-  
46 month school year (September to June) for 5 years  
47 (the duration of secondary school), for a total of 20  
48 survey cycles. Survey cycle 21 collected data when  
49 participants were aged 20 years on average. The base-  
50 line response proportion was 55%; refusals to par-  
51 ticipate related to the need for blood sampling for  
52 genetic analysis (data not used in the present study)  
53 and a province-wide labor dispute that resulted in  
54 some teachers not collecting consent forms. The study  
55 population for the current analyses included 808 par-  
56 ticipants (62% of the baseline sample) with PA data  
57 during secondary school and at age 20.

## Procedure

1 Data for this analysis were available in the Nicotine  
2 Dependence in Teens (NDIT) Study, a prospective  
3 cohort investigation of the natural course of nicotine  
4 dependence in adolescents.<sup>19</sup> We obtained informed  
5 assent from participants and active consent from  
6 parents or guardians. The NDIT Study was approved  
7 by the ethics review boards at the McGill University  
8 Faculty of Medicine, the Direction de santé publique  
9 de Montreal-Centre, and the *Centre de Recherche du*  
10 *Centre Hospitalier de l'Université de Montréal* (CRCHUM).  
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## Instruments

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15 Data on number of PA sessions per week were  
16 collected in a 7-day recall adapted from the Weekly  
17 Activity Checklist.<sup>20</sup> The question was worded: "Think  
18 about the physical activities that you did last week from  
19 Monday to Sunday outside your regular school gym  
20 class. For each activity that you did for 5 minutes or  
21 more at one time, mark an "X" to show the day(s)  
22 on which you did that activity. . . ." followed by a list  
23 of 29 activities. The activity checklist included 6 light,  
24 17 moderate, and 6 vigorous activities based on esti-  
25 mated energy expenditures of <4.8, 4.8-7.1 METS and  
26 >7.1 METS, respectively.<sup>21</sup> Participants checked which  
27 activities they had engaged in on each day of the previ-  
28 ous week. The Weekly Activity Checklist is correlated  
29 with objectively measured PA (Caltrac accelerometer)  
30 at  $r = .34$ .<sup>20,22</sup> The 2-week test-retest reliability of our  
31 adapted checklist was  $r = .73$ , which is similar to the  
32  $r = .76$  observed using accelerometers in youth.<sup>23,24</sup>  
33 The total number of PA sessions engaged per week was  
34 computed to create a continuous measure. To mini-  
35 mize the effect of seasonal variation in PA,<sup>25</sup> data from  
36 survey cycles conducted within the same school year  
37 (ie, survey cycles 1-4, 5-8, 9-12, 13-16, 17-20) were  
38 summed to estimate the average number of PA sessions  
39 weekly during each school year from age 13 to 17.

40 To obtain an estimated number of intramural and  
41 extramural sports opportunities in each study school,  
42 school principals or vice-principals completed a check-  
43 list in survey cycle 12 (ie in the third year of the study)  
44 that detailed the number of intramural and extramural  
45 sports available in their schools. The intramural ques-  
46 tion was worded: "During a normal school year, which  
47 of the following intramural sports (outside the regular  
48 physical education curriculum) are available at your  
49 school (at any grade level). . . ." followed by a list of 17  
50 sports. The extramural question was worded similarly  
51 and included a list of 21 sports. The 3 schools with the  
52 highest number of intramural sports ( $n > 8$ ) were cat-  
53 egorized as "high intramural schools," and the other 7  
54 schools were categorized as "low intramural schools."  
55 Similarly, the 3 schools with the highest number of  
56 extramural sports ( $n > 9$ ) were categorized as "high  
57 extramural schools," and the remaining 7 schools

1 were categorized as “low extramural schools.” Cut-  
 2 points were selected empirically based on a natural  
 3 break in the distributions of the number of intramural  
 4 or extramural sports opportunities available in each  
 5 school (ie, with 3 schools tending to cluster around  
 6 10 and 7 schools tending to cluster around 4). As  
 7 well, this categorization was used in a previous NDI  
 8 analysis.<sup>26</sup>

9 Covariates including age, sex, body mass index  
 10 (BMI), mother’s education, and school socioeconomic  
 11 status (SES) were selected based on previous research  
 12 indicating that these variables are associated with  
 13 PA.<sup>26-31</sup> Height and weight as measured by trained  
 14 and certified technicians in survey cycle 1 using a  
 15 standardized protocol<sup>32</sup> were used to estimate BMI  
 16 (kg/m<sup>2</sup>). Participants were categorized as either over-  
 17 weight/obese (if they were  $\geq$  85<sup>th</sup> age- and sex- specific  
 18 percentile from the CDC growth charts) or normal  
 19 weight.<sup>33</sup> Mother’s education was measured in survey  
 20 cycle 13 by asking adolescents “How much education  
 21 has your mother had?” Response choices included:  
 22 (1) did not finish high school, (2) high school gradu-  
 23 ate, (3) vocational school, (4) CEGEP (ie, a 2-year  
 24 pre-university program similar to community college),  
 25 (5) university, and (6) other. Participants were cat-  
 26 egorized according to whether or not their mother  
 27 had completed university (yes, no). School SES was  
 28 based on average parental income per year in each  
 29 school,<sup>5,34</sup> dichotomized at the 75<sup>th</sup> percentile as high  
 30 (ie, if  $>$ \$75,000) or moderate/low SES.

### 31 32 33 Data Analysis

34 The association between number of intramural and  
 35 extramural sports opportunities was examined using  
 36 Spearman’s rank order correlation coefficients. To  
 37 describe the association between PA and the avail-  
 38 ability of intramural or extramural sports, a multilevel  
 39 general linear model was fit to the data using a step-up  
 40 approach.<sup>35</sup> The hierarchical data had a 3-level struc-  
 41 ture, with time (ie repeated measures) nested within  
 42 individuals, and individuals nested within schools. The  
 43 null model partitioned the variance between the 3 lev-  
 44 els. Average weekly PA sessions for each participant  
 45 were estimated in the repeated-measures model. The  
 46 full model examined associations between individ-  
 47 ual PA and school intramural and extramural sports  
 48 adjusting for school SES as well as for differences  
 49 between schools with respect to participant character-  
 50 istics (ie, BMI, sex, and mother’s education) and school  
 51 SES. The associations of intramural and extramural  
 52 sports with PA were mutually adjusted.

53 This multilevel step-up approach was used to exam-  
 54 ine the association between each of total, moderate,  
 55 and vigorous PA and each of intramural and extra-  
 56 mural sport opportunities, adjusting for BMI, sex,  
 57 mother’s education, and school SES.

## RESULTS

1 The mean age of participants at baseline was  
 2 12.7 (SD = 0.5) years; 46% of the sample was  
 3 male (Table 1). Approximately two-thirds (65%) of  
 4 participants attended an English language school, and  
 5 74% attended a moderate/low SES school.

6 Schools offered 5.5 (SD = 1) intramural and 5.5  
 7 (SD = 1.5) extramural sports opportunities on aver-  
 8 age. Approximately 3-in-10 of participants attended  
 9 either a high intramural school (28%) or a high extra-  
 10 mural school (29%). Number of intramural sports was  
 11 not statistically significantly correlated with number of  
 12 extramural sports (Spearman’s rank order correlation  
 13 coefficient =  $-0.26$ ,  $p = .47$ ).

14 In the multilevel general linear analyses, the null  
 15 model for total PA showed that 59%, 37%, and 4%  
 16 of the variance in PA was within-person, between-  
 17 person, and between-school, respectively. The average  
 18 number of PA sessions weekly was estimated to be  
 19 18.2, 17.8, 15.5, 13.9, 13.3, and 5.7 at ages 12-13,  
 20 14, 15, 16, 17, and 21, respectively. Physical activity  
 21 levels at ages 15, 16, 17, and 21 were statistically  
 22 significantly lower than at age 12-13. Controlling for  
 23 age, sex, BMI, mother’s education, and school SES,  
 24 the model revealed that adolescents in high intramural  
 25 schools participated in 3.6 ( $p = .03$ ) more PA sessions  
 26 weekly on average than adolescents in low intramural  
 27 schools (Figure 1; Table 2). There was no statistically  
 28 significant difference in the average number of PA  
 29 sessions weekly among adolescents in high versus  
 30 low extramural schools (Figure 2). The intramural and  
 31 extramural sports variables accounted for 28% of the  
 32 school-level variance in total PA.

33 The multilevel general linear analyses for moderate  
 34 PA showed that the average number of moderate PA

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37  
38 Table 1. Comparison of selected baseline characteristics of  
 39 participants in high and low intramural and extramural  
 40 schools (NDIT Study, 1999-2007)

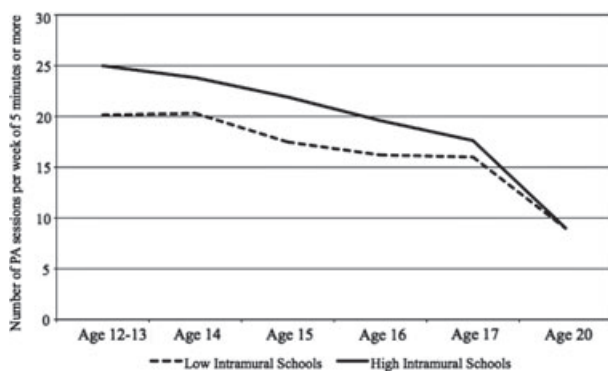
Variables	High Intramural Schools (n = 3)	Low Intramural Schools (n = 7)	High Extramural Schools (n = 3)	Low Extramural Schools (n = 7)
Number of participants	225	583	236	572
Age, years, mean (SD)	12.6 (0.4)	12.7 (0.5)	12.6 (0.4)	12.7 (0.5)
Male, %	46	45	48	45
PA sessions/week, mean (SD)	24 (16)*	17 (12)	18 (14)	19 (13)
Overweight, %	30	29	25	31
Mother with university education, %	63	68	78*	61

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PA, physical activity.

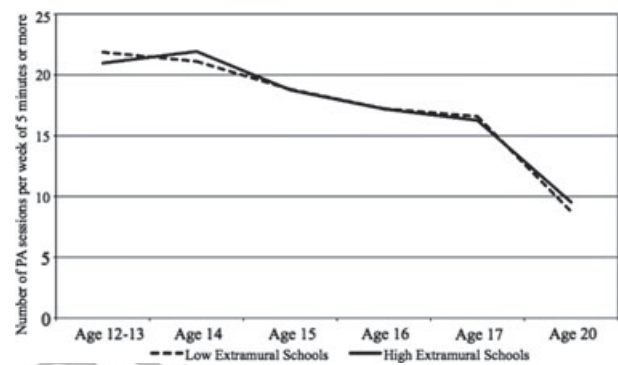
\* $p < .001$  for difference between schools with high and low intramural or extramural sports.



1 Figure 1. Total Unadjusted Physical Activity (PA) Sessions Per  
2 Week From Ages 12-13 to 20 for Students in High and Low  
3 Intramural Schools (NDIT Study, 1999-2007)



1 Figure 2. Total Unadjusted Physical Activity (PA) Sessions Per  
2 Week From ages 12-13 to 20 for Students in High and Low  
3 Extramural Schools (NDIT Study, 1999-2007)



18 Table 2. Standardized Beta Coefficients ( $\beta$ ) and Standard Error  
19 Obtained From Multilevel General Linear Models Examining  
20 the Association Between Number of Total, Moderate, and  
21 Vigorous Physical Activity Sessions Per Week and Number of  
22 Intramural and Extramural Sports (NDIT Study, 1999-2007)<sup>†</sup>

	Total PA $\beta$ (SE)	Moderate PA $\beta$ (SE)	Vigorous PA $\beta$ (SE)
Intercept	18.2 (1.6) <sup>†</sup>	10.2 (0.6) <sup>†</sup>	4.8 (0.3) <sup>†</sup>
Level 3 schools			
High intramural (ref: low)	3.6 (1.5)*	1.1 (0.9)	1.3 (0.5)*
High Extramural (ref: low)	1.6 (1.3)	0.4 (0.8)	0.5 (0.4)
High SES (ref: low)	0.4 (1.2)	1.2 (0.8)	-0.2 (0.4)
Level 2 students			
Overweight (ref: normal weight)	0.1 (0.1)	0.5 (0.3)	0.2 (0.2)
Male (ref: female)	1.9 (0.5)**	0.8 (0.3)**	0.4 (0.1)**
Mother's education (ref: university)	-1.0 (0.5)	-0.5 (0.3)	-0.3 (0.2)*
Level 1 repeated measures			
Age, years (ref: 12-13)			
14	-0.4 (0.3)	-0.9 (0.2) <sup>†</sup>	1.0 (0.1) <sup>†</sup>
15	-2.7 (0.3) <sup>†</sup>	-2.4 (0.2) <sup>†</sup>	0.5 (0.1) <sup>†</sup>
16	-4.3 (0.3) <sup>†</sup>	-3.2 (0.2) <sup>†</sup>	0.4 (0.1)*
17	-4.9 (0.3) <sup>†</sup>	-3.9 (0.2) <sup>†</sup>	0.1 (0.1)
20	-12.5 (0.3) <sup>†</sup>	-7.8 (0.2) <sup>†</sup>	-4.2 (0.1) <sup>†</sup>

41 PA, physical activity; SE, standard error.

42 \* $p < .05$ , \*\* $p < .01$ , <sup>†</sup> $p < .001$ .

43 <sup>†</sup>Variance components total PA: level 3 = 4%, level 2 = 37%, level 1 = 59%. Variance  
44 components moderate PA: level 3 = 5%, level 2 = 33%, level 1 = 62%. Variance  
45 components vigorous PA: level 3 = 5%, level 2 = 21%, level 1 = 74%.

46 sessions weekly was 10.2, 9.3, 7.8, 7, 6.3, and 2.4 at  
47 ages 12-13, 14, 15, 16, 17, and 21, respectively. Moder-  
48 ate PA levels at ages 14, 15, 16, 17, and 21 were statisti-  
49 cally significantly lower than at age 12-13. There were  
50 no statistically significant association between number  
51 of moderate PA sessions weekly and either intramural  
52 ( $p = .27$ ) or extramural ( $p = .63$ ) sports (Table 2).

53 The multilevel general linear analyses for vigor-  
54 ous PA showed that the average number of vigorous  
55 PA sessions weekly was 4.8, 5.8, 5.3, 5.2, 4.9, and  
56 0.6 at ages 13, 14, 15, 16, 17, and 21, respec-  
57 tively. The average number of vigorous PA sessions

18 weekly decreased statistically significantly between  
19 ages 17 and 21 ( $p = .01$ ). Adolescents in high intra-  
20 mural schools participated in 1.3 ( $p = .03$ ) more  
21 vigorous PA sessions weekly on average than adoles-  
22 cents in low intramural schools (Table 2). Extramural  
23 sports were not statistically significantly associated  
24 with the number of vigorous PA sessions weekly  
25 ( $p = .23$ ).

26 The PA variable was positively skewed. To ensure  
27 that our results were robust to a skewed distribution,  
28 we repeated the multilevel analysis using square root  
29 transformed PA data, Poisson distribution multilevel  
30 analysis, and a dichotomous (active/inactive) PA vari-  
31 able.  $p$ -Values and standard errors from all multilevel  
32 analyses were similar and did not change the inter-  
33 pretation of the results. For ease of interpretation, we  
34 presented untransformed results. In addition, in sensi-  
35 tivity analyses that removed light intensity activity  
36 from the PA measure,  $p$ -values did change little and  
37 the results were robust.

## DISCUSSION

41 The purpose of this study was to examine if there is  
42 an association between the availability of intramural  
43 and extramural sports in secondary school and total,  
44 moderate, and vigorous PA levels in adolescents during  
45 secondary school and then as young adults. The anal-  
46 ysis shows that participants attending schools with  
47 a high number of intramural sports reported higher  
48 levels of total and vigorous PA than participants attend-  
49 ing schools with fewer intramural sports, regardless  
50 of whether or not they participated in the intramu-  
51 ral sports program. This appeared to be attributable  
52 primarily to increased participation in vigorous PA.  
53 Possible mechanisms underpinning the apparent ben-  
54 efiticial effect of attending a high intramural school may  
55 include a school environment which reinforces posi-  
56 tive attitudes toward PA. These positive attitudes may  
57 support increases in PA behavior that track beyond

1 secondary school.<sup>27,36</sup> Opportunities for extramural sports were not associated with level of PA, regardless of participation in extramural sports programs. Independent of the availability of intramural or extramural sports opportunities, all adolescents reported marked declines in PA levels between ages 13 and 20.

2 Our results support and nuance current recommendations that intramural sports in secondary school be made available to provide opportunities for students to be physically active.<sup>2,11-13</sup> For teachers and school staff working in schools currently without intramural programs, our results provide preliminary evidence suggesting that implementing intramural sports opportunities in schools may be 1 way to help adolescents in the school achieve recommended PA levels. For teachers and school staff working in schools with intramural programs, significant PA differences between schools with a high and low number of intramural sports suggest that intramural programs with a small number of sports opportunities available may not be sufficient to increase the PA of students.

3 Current national and international PA guidelines suggest that adolescents should participate in 60 minutes or more of PA daily. Yet, moderate and vigorous PA decline dramatically during secondary school.<sup>5,6</sup> Vigorous PA shows steeper declines than total or moderate PA.<sup>5</sup> Our results suggest that although vigorous PA declines among all adolescents, attending a school with a high number of intramural sports may help adolescents maintain higher levels of vigorous PA throughout secondary school. This result is important considering role of vigorous PA in healthy growth and development and chronic disease prevention.<sup>1-3,37</sup>

4 The literature on physical education suggests that extramural sports are implemented in 80-90% of schools in Canada and the United States.<sup>17</sup> However, compared with intramural sports, extramural sports appear to have limited potential for increasing PA at the school level, possibly because they typically involve fewer students and involve the more elite athletes, and thus do not provide opportunities for a wide range of abilities.<sup>8,9,17</sup> Consequently, although school-based, they may not be an optimal approach for increasing PA in the general population of adolescents. Our results are consistent with the physical education literature,<sup>8,9,17</sup> in that students in schools with many extramural sports opportunities had similar levels of PA compared to those in schools with few extramural sports opportunities.

### 53 Limitations

54 Limitations in the present study include that the number of intramural and extramural sports was measured only once in survey cycle 12 when participants were aged 16 years on average. It is possible that the

number of intramural and extramural sports opportunities varied within schools over the 5 years. We assumed that any variation was minimal. Because study schools comprised a convenience sample, the external generalizability of the results may be limited. However, schools were selected specifically to represent a broad and diverse sample. The PA data were based on self-reports that may be prone to recall bias, and in addition correlated only moderately with objective measures of PA. However, repeated assessments of PA over time may have mitigated measurement error and provided a more valid estimate of PA levels in youth.<sup>38</sup>

### Conclusion

Our study suggests that adolescents who attend schools with more intramural sports opportunities are more physically active, regardless of whether or not they participated in intramural sports. If this association is causal, providing more intramural sports at school, and promoting increased participation in intramural sports, may be effective public health strategies to help adolescents meet current PA recommendations.

### IMPLICATIONS FOR SCHOOL HEALTH

The present study underscores the importance of school policies that make sports, and in particular intramural sports, widely available at school. A variety of intramural sports opportunities should be offered to maximize participation, promote a culture conducive to involvement in PA, and encourage sustained participation over the life course. School sports programs should recognize that PA levels decline dramatically during adolescence and target students of all ability levels.

### Human Subjects Approval Statement

The study was approved by institutional review boards at the McGill University Faculty of Medicine, the Direction de santé publique de Montreal-Centre, and the *Centre de Recherche du Centre Hospitalier de l'Université de Montréal* (CRCHUM).

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