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An Assessment of Sedentary Time Among Undergraduate Students at a Canadian University

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ABSTRACT

International Journal of Exercise Science 10(8): 1116-1129, 2017. The purpose of this study was to calculate a total daily sedentary time for the undergraduate population at a large urban Canadian University and investigate student perceptions of the facilitators and barriers to engaging in a less sedentary lifestyle. A sample of 335 participants responded to an online questionnaire that included the SIT-Q and open-ended questions, with 102 providing sufficient data to be included in the quantitative analysis and 145 in the qualitative analysis. Students spent an average of 11.88 ± 3.46 hrs/day engaged in sedentary behaviors. Three themes were identified as facilitators to engaging in a less sedentary lifestyle: 1) access to a gym, 2) student jobs, and 3) walking to and on campus. Two themes were identified as barriers to engaging in a less sedentary lifestyle: 1) sitting in class and 2) studying outside of class. Similar to desk-based working adults, undergraduate students have levels of sedentary behavior that warrant further investigation and intervention, perhaps most effectively within the university classroom.

KEY WORDS: Sedentary behavior physical activity, college students, university students, student perceptions

INTRODUCTION

In recent years, sedentary behavior researchers have made significant strides toward determining the health outcomes associated with excessive sedentary pursuits. Living a sedentary lifestyle puts people at risk of developing obesity, breast cancer, colon cancer, hypertension, diabetes and an overall risk of hospitalization (29), completely independent of whether or not these individuals participate in adequate levels of moderate to vigorous physical activity (7). In addition, evidence is emerging that inactivity results in physiological mechanisms, termed inactive physiology, that may eventually lead to a reduced quality and quantity of life (10). The sit-stand desk has been solidified as an effective tool to reduce total sedentary time throughout the day (11) and although an optimal sit-stand ratio has not yet been determined (13), light activity breaks from sitting have been shown to reduce impairments to the superficial femoral artery (27). Sedentary behavior researchers continue to make important contributions to the growing knowledge base of sedentary behavior. However, a significant gap in the populations studied, as well as controversy pertaining to the

objective definition of sedentary behavior, pose problems to those researchers who aim to determine the true prevalence of sedentary behavior throughout society.

Sedentary behavior has been defined as any waking behavior characterized by an energy expenditure of ≤ 1.5 metabolic equivalents (METs) while in a seated or reclining posture (26). This definition has been cited by numerous sedentary behavior researchers (19,3) as well as cited on the Sedentary Behavior Research Network (SBRN), demonstrating some consensus among the academic community. However, recent evidence (18) suggests that it is possible for an individual to participate in traditional sedentary behaviors such as typing and playing video games and have an energy expenditure of over 1.5 METs, while other individuals have energy expenditures of less than 1.5 METs while standing and therefore not exhibiting sedentary behavior based on the current definition. This evidence calls for a modification of the commonly cited definition of sedentary behavior. Reducing the definition to energy expenditure and posture simplifies the term and provides researchers with a means of gathering information on what activities constitute sedentary behavior and how long an individual might be participating in these activities each day. However, the current definition makes it challenging to advance knowledge on just how long an individual should be active each day in order to avoid negative health effects. Based on the Canadian Physical Activity Guidelines (CPAG), physical inactivity can be defined as participation of less than 150 minutes of moderate to vigorous physical activity per week (28). A similar definition that clarifies the point at which sedentary behavior is at a dangerous threshold would help to fully understand the magnitude of the sedentary behavior problem in society. Currently, it is unknown how many minutes/hours or what percentage of a day an individual should avoid being sedentary to maximize health gains and eschew associated negative health consequences. As research into sedentary behavior proliferates, researchers will be better positioned to create more concrete measures of health-related sedentary guidelines.

The health risks associated with sedentary behavior exist across the entire life span from school-aged children (28), working aged adults (22), to the 60+ population (8). However, significantly less attention has focused on the sedentary behavior of university-aged students (4), leaving an important gap in the research. On average, desk-based workers sit for 6 hours out of an 8-hour work day (1), and are therefore heavily targeted for intervention. In many ways, it is plausible that university undergraduates work similar to white collar, desk-based jobs (e.g., seated at a desk in lectures, library and at home for hours at a time).

It is important to understand the daily activity patterns of young people as they enter a formative stage and develop the foundation of adult life patterns (12). Students who attend university are the leaders and decision makers of tomorrow and may establish social and cultural norms for the entire population (15). These students evolve into teachers, health practitioners, and managers who influence the health behaviors of the rest of the population (24). It is therefore important to understand and quantify the sedentary behavior of university undergraduates in order to understand the extent to which sedentary behavior is of concern for this population, and to eventually establish functional interventions to decrease this behavior during a time when their long-term lifestyles are being formed.

Therefore, the purpose of this study was to calculate a total daily sedentary time for the undergraduate population at a large urban Canadian University and investigate students' perceptions of the facilitators and barriers to engaging in a less sedentary lifestyle. It was hypothesized that undergraduates would have levels of sedentary behavior that mimic or even surpass white-collar workers. There is a paucity of previous research on different group's perceptions of sedentary behavior facilitators and barriers, and thus we hypothesized that students who chose to respond to the open-ended questions would provide on campus-based intervention components for reducing student sedentary behavior.

METHODS

Participants

This cross-sectional study included a sample of full-time, male and female undergraduate university students from an urban Canadian university in the Fall semester of 2015. Part-time and graduate students were excluded. The University's Research Ethics Board approved this study prior to any recruitment taking place. The majority of the participants were female ($n=81$, 79.41%) and Caucasian ($n=77$, 75.49%), with all participants between the ages of 17 and 34 years. There was a rather even distribution of respondents included from each year of study with most enrolled in fourth year ($n=34$, 33.33%) and the largest portion from the Faculty of Health Sciences ($n=53$, 51.96%). The majority of students were unemployed ($n=61$, 59.8%) with the remaining students working part-time jobs ($n=40$, 39.21%) and one (1) working a full-time job (Table 1).

Protocol

Emails were sent to professors from various faculties. Approximately 400 individual emails were sent to professors in every faculty and spanning all years of enrollment in order to be as inclusive as possible and provide an average sedentary time that would be generalizable to the entire undergraduate population on campus. The email included the letter of information and a link to the survey and asked permission to visit each professor's classroom in order to make a short announcement to their class extending an invitation to participate in the study (note: professors were also informed of the ethics imposed requirements that they leave the room while the announcement was made and that they could not post the invitation on their course websites). The online survey consisted of three sections: Part A - Demographic Information, Part B - The SIT-Q Sedentary Behavior Questionnaire, and Part C - Student Perceptions of Facilitators and Barriers to Reducing Their Sedentary Behavior.

The 18-item SIT-Q is a domain specific questionnaire that tracks the sedentary behavior of adults in 6 domains: 1) sleeping and napping 2) meals 3) transportation 4) work, study, and volunteering 5) child and elder care and 6) light leisure and relaxing. There was also a final section titled "final questions". The items included categorical and continuous variables that allowed total daily sedentary time to be calculated for weekdays and weekends. The SIT-Q was developed and validated by Lynch and colleagues (17) with total daily sitting time demonstrating fair to good intraclass correlation coefficients ($ICC = 0.65$, 95% CI: 0.49, 0.78).

Table 1. Demographic Information (N = 102)

Characteristic	n	%
Sex		
Male	20	19.61
Female	81	79.41
Other	1	0.98
Age		
19 and under	37	36.27
20-24	63	61.76
25-29	1	0.98
30-24	1	0.98
Ethnicity		
Aboriginal	0	0
African	1	0.98
Caucasian	77	75.49
East Asian	11	10.78
Hispanic	3	2.94
Mid. East	2	1.96
South Asian	3	2.95
Other	5	4.90
Program of Registration		
Health Sci	53	51.96
Arts	2	1.96
Engineering	11	10.78
Science	18	17.65
Social Science	16	15.69
Other	2	1.96
Year of Enrollment		
First		
Second	14	13.72
Third	27	26.47
Fourth	17	16.67
Fifth	34	33.33
	9	8.82
Employment		
Full-time		
Part-time	1	0.98
Unemployed	40	39.21
	61	59.80

Note. Responses may not reflect the total number of participants, and thus, not all percentages add up to a hundred percent due to responses received.

Other ICCs ranged from poor (0.31) for computer use during leisure time to excellent (0.86) for occupational sitting time. Overall, the SIT-Q demonstrated moderate validity with total sitting time showing a Spearman's correlation coefficient of 0.53. Despite its challenges, the SIT-Q

was chosen as the primary methodological tool based on a number of its strengths. According to Owen et al. (20), adult determinants of sedentary behavior are different depending on what domain of life in which they occur. The multi-domain needs for the current study was met by the SIT-Q's unique design, spanning 6 domains and developed through the rigorous 3-stage process of expert review, cognitive interviewing, and pilot testing (17). In addition, the SIT-Q was deemed the most appropriate tool for the population of undergraduate students due to its domain of work, study, and volunteering. Following the SIT-Q, participants were asked: "What facilitators exist (at school, home, work, transportation) that aid in your ability to engage in a less sedentary lifestyle?" and "What barriers exist (at school, home, work, transportation) that hinder your ability to engage in a less sedentary lifestyle?" These questions were answered in written form.

Statistical Analysis

Students who were enrolled on a part-time basis and failed to provide information on time allocated to study were excluded from analysis. Therefore, although 335 completed some parts of the questionnaire, 102 were included in the analysis. Using the scoring protocol of its creators (17) to analyze the results of the SIT-Q, sedentary behavior was assessed separately for weekdays and weekends, except for work, study and volunteering. This domain was reported using continuous variables (i.e., written response) and was based on weeks per year, days per week, and hours per day. Due to the fact that participants did not work every day, the descriptive statistics for work, study and volunteering was summarized as hours or minutes in the work/study/volunteering domain per week. To calculate total sedentary time, minutes per day were totaled and averaged. To analyze the two open-ended questions about facilitators and barriers to reducing sedentary time, inductive content analysis (21) was completed by both the lead author and a research assistant and then compared to enhance the data's confirmability (9). This process allowed for the identification of frequent responses and theme categories.

RESULTS

The results from the SIT-Q are reported in Tables 2 and 3. Students spent an average of 11.88 ± 3.46 hours per day engaged in sedentary behaviors. This total average includes time spent napping, eating meals, in transportation, doing work/study/volunteering, and participating in leisure activities. An average of 7.37 hours per day on weekdays and 8.68 hours on weekends were spent sleeping. The most common sedentary behaviors were watching television (weekday: 1.40 hours/day, weekend: 2.51 hours/day) and computer use for leisure activities (weekday: 2.25 hours/day, weekend: 2.77 hours/day) while almost no time was spent caring for a child (weekday: 0.59 mins/day, weekend: 1.74 mins/day) or an elderly family member (weekday: 2.94 mins/day, weekend: 6.42 mins/day). Paired sample t-tests were performed to compare sitting times within each individual domain between weekdays and weekends. Sleeping, eating meals, watching TV, computer use and other leisure time were all significantly greater on weekends. The domains of napping and transportation were greater on weekdays but were not significantly different.

Table 2. Comparison of total sedentary time (hours/day \pm SD) on weekdays and weekends (N=102).

Sedentary Behavior (hrs/day)	Week-day	Week-end	<i>p-value</i>
	Mean \pm SD	Mean \pm SD	
Sleeping	7.36 \pm 1.10	8.68 \pm 1.11	<0.01
Napping	0.32 \pm 0.58	0.23 \pm 0.55	0.19
Meals	1.17 \pm 0.79	1.45 \pm 0.91	<0.01
Transport	0.85 \pm 1.15	0.73 \pm 0.81	0.32
Child Care	0.01 \pm 0.10	0.03 \pm 0.22	0.32
Elder Care	0.05 \pm 0.36	0.11 \pm 0.67	0.16
TV Time	1.40 \pm 1.26	2.51 \pm 1.93	<0.01
Computer Time	2.25 \pm 1.94	2.77 \pm 2.24	<0.01
Reading	1.08 \pm 1.23	1.39 \pm 1.52	0.08
Other Leisure	0.71 \pm 0.85	1.35 \pm 1.57	<0.01

Table 3 presents the data obtained from Section 4 of the SIT-Q: Work, Study, and Volunteering. Students spent an average of 3.29 ± 1.71 hours per day engaged in sitting during work, study, and volunteering. An average of 0.52 ± 0.82 hours/day was spent sitting during work, 2.70 ± 1.68 hours/day during study, and 0.050 ± 0.22 hours/day during volunteering.

Table 3. Total Sedentary Time (hours/day \pm SD) during work, study and volunteering (N=102).

Job	Mean \pm SD
Work	0.52 ± 0.82
Study	2.70 ± 1.68
Volunteering	0.050 ± 0.22

Table 4 presents the average total sedentary time per day based on program of registration and employment status. The amount of sedentary time attributed to study for each program of registration is also provided. Total sedentary time was consistent throughout the different programs and whether a student was employed or unemployed had little effect. The time attributed to study per day was also consistent throughout the various programs.

Table 4. Total Sedentary Time (hours/day \pm SD) based on program and employment status.

Demographic	Mean \pm SD	Study Time
Program of Registration		
Health Sciences	11.84 ± 3.35	2.72
Engineering	11.66 ± 3.58	2.73
Science	11.86 ± 3.54	2.69
Social Science	11.76 ± 3.59	2.71
Arts	14.83 ± 2.21	1.76
Other	12.52 ± 3.50	4.28
Employment Status		
Part-Time	11.84 ± 3.58	
Unemployed	11.86 ± 3.54	

A total of 145 students responded to the open ended questions and were included in the qualitative analysis. The responses were coded and key themes were identified for the facilitators and barriers to engaging in a less sedentary lifestyle. Three themes were identified

for facilitators (i.e., access to the gym; student jobs; and walking to and on campus) and two themes were identified for barriers (i.e., sitting in class and studying outside of class). Table 5 presents select quotations that reflect the common sentiments presented by participants for the themes identified for facilitators. Table 6 presents select quotations for the themes identified for barriers (please note: no changes/edits were made to the punctuation or language of respondents).

Table 5. Select Quotations Supporting Reflecting Facilitators That Aid in Engaging in a Less Sedentary Lifestyle.

Access to the Gym

"The gym is close to where I live. My university program promotes an active lifestyle. I have good friends that exercise regularly."

"Intramural sports and other leagues. Gyms and athletic places in the vicinity of where I live"

"Gym close, I don't have a car"

"I have a gym membership with [University] that is included in my tuition."

"Access to Gym at the university, Exercise routines available free and easily on the internet, transport to and from Gym."

"School gym (having a gym easily accessible o campus motivates me to work out more/sit less)"

Student Jobs

"work (because my current job requires me to stand up)"

"Work back of house at a computer store consistently bringing computers to and from the front of the house."

"At the hospital and working in a warehouse requires you to be constantly walking to do the job."

"Part-time work in a lab, I have no chair or desk to work at."

"Sit-stand desks at work are great to break up extended periods of sitting!"

"working as a server you rarely get to sit, so that keeps me moving and not sedentary."

Walking to and on Campus

"I have to walk most places on campus"

"distance between classes"

"ability to walk to class (close to campus)"

"University campus being large and having to walk from class to class"

"Living close to school helps me be less sedentary because when I get to walk to school instead of sit on a bus."

Note. This table contains the most relevant quotations. Multiple answers came in single word form or very limited responses such as "gym", "walking to classes", and "school, work, and extracurricular activities".

Table 6. Quotations Supporting Themes Identified as Barriers to Engaging in a Less Sedentary Lifestyle.

Sitting During Lecture

"school is usually sitting down during a lecture"

"There are no standing desks at school, all lecture halls have seats"

"limitations in the classroom"

"Having to sit in long lectures with breaks only in the middle – Studying time is the majority of my seated time."

"forced to sit in lectures"

"Classes often in the same room or building...36+ hours a week of class, so 36+ hours a week spend sitting"

"Lecture halls with no option for standing desks or no moving breaks"

"Having no where to stand with a table during lectures...there's no option to stand or stretch your legs"

"Lack of breaks during two hour lectures"

"regular lecture hall arrangement"

Studying Outside of Class

"A lot of work to do, and not many options are available to do this standing up comfortably. So much work to do, it is hard to leave it to stand up or walk somewhere. Feels like I am wasting time that could be spent doing homework."

"I don't have a standing desk at home for study."

" 'Some work just has to be done sitting down'. For example, reading, writing an essay, etc."

"I have a lot of readings, assignments, essays and other projects which require me to sit and focus in order to complete."

"Almost all schoolwork needs to be completed sitting down."

"Most work needs to be done at my desk."

"A lot of work has to be done sitting down obviously and that takes a lot of time."

"The only comfortable way to study is sitting down."

Note. This table contains the most relevant quotations. Multiple responses came in single word form or very limited responses such as "class" and "homework".

The majority of students who responded answered that the recreational center on campus helps them reduce their daily sedentary behavior. Many students expressed that the center provides many classes, multiple exercise routines, and intramural sports. Additionally, multiple students stated that the close proximity of their home to the gym made getting there easier; they did not have to rely on a car or public transit in order to workout. Some students

mentioned that having the gym membership included in tuition helps them to reduce their sedentary behavior while one student even mentioned that the gym membership was “free”.

Many students indicated that jobs during school and in the summer months are jobs that require them to be standing or walking around. Participants mentioned jobs as servers, volunteering at a hospital transferring patients, working in warehouses, and in labs where there is no chair for sitting. All jobs mentioned were jobs that typically do not require, or allow sitting while working other than during designated break times, with the exception of one student noting the use of a sit-stand desk at work to break up periods of sitting.

A large number of students expressed that they often walk to and from school. Some of these students noted that they live very close to school while others stated that they walk for long periods of time. When they are on campus, multiple students expressed that they have to walk across campus to get from one class to another because they often have classes in separate buildings. Others noted that they walk to the bus stop in order to get to school. Active forms of transport were reported as common among participants.

The majority of students identified that a large amount of their sedentary behavior is related to the amount of time they spend sitting down during lectures (with no other option for the entire lecture with the exception of small breaks). However, some students noted that in some lectures, breaks are not always provided. Some students phrased the problem as “limitations in the classroom” while other students expressed that “school makes you sit during class” and that they are “forced to sit in class”.

Students also identified that for those who wish to study on campus in the library, there are no options other than sitting. In addition, the majority of students identified that when they are studying at home, the only option that exists is to study while sitting down. Despite having some control over the environment at home, students expressed that sitting during private study is “required”. A few students mentioned that they do not have access to a standing desk at home to solve this problem and many responded with phrases suggesting that even if a standing desk was available, the work that needed to be done could only be completed in a seated position. For others, sitting while studying was about comfort while others stated that it was about being able to focus.

DISCUSSION

The primary purpose of this study was to identify the total daily sedentary time of full-time undergraduate students at an urban Canadian university and to explore facilitators and barriers to engaging in a less sedentary lifestyle. The a priori hypothesis that undergraduate students would have sedentary behavior levels that equal or surpass desk-based working adults, with similar sedentary times between office-based work and study was supported, to an extent. Rosenberg et al. (24) found their sample of 842 men and women had a total weekly sedentary time of 65.6 hours or 9.4 hours a day, which is 2.48 hours less than the undergraduate students of the current study. Rosenberg et al. (24) used the Sedentary

Behavior Questionnaire (SBQ) as their measurement tool which explored similar domains as the SIT-Q with the major difference being that the SBQ does not include information on “study”.

While the current study supports the notion that undergraduates spend more time sedentary than white-collar adults, the findings did not demonstrate that they spend similar amounts of time sitting when engaged in work versus study and therefore, the findings only partially support the initial hypothesis. The current study found that students spend an average of 2.7 hours of their daily sedentary time engaged in study (lecture and private study) while Alkhajah et al. (1) found that office-based employees sit for 6 hours during their work day. However, the amount of time allocated to “study” may have been grossly under reported. Like every domain included in the SIT-Q, the study, work, and volunteering section is calculated for the entire year. For most of the population, this makes logical sense as an individual could work, volunteer, and attend classes at any point throughout the year. However, the study aspect of this domain is problematic when calculating the average time an undergraduate student spends sitting in the past 365 days because full-time students at the host institution are typically enrolled in classes from the beginning of September to the end of April. For example, one participant reported that in the past year he/she was sitting for the purpose of study for 32 weeks, 7 days per week, and for 6 hours a day, equaling a total of 1,344 hours over the entire year. Recalculating this for each day over the past year, the student spent 3.68 hours each day sitting during study. This daily average is essentially “watered down” because of the approximately 16 other weeks in which the student is not attending classes or privately studying. Due to this limitation in the scoring protocol for this specific population, we estimated that the sedentary time is higher for the time a student is actually in school and not off for the summer months. As such, the true average of sitting time allocated to study each day for a student could be much closer to the 6 hours a day office workers spend sitting as reported by Alkhajah et al. (1) and therefore, makes the study environment a potential target for intervention. The reported total sedentary time of 11.88 hours/day is more than the sedentary times of undergraduate students within the United States (4), and we estimate that the actual total would be even greater than reported due to the limitation in the scoring protocol of the SIT-Q for undergraduates. It stands to reason that the greatest chance for change in a student’s sedentary time is within the domain that the student spends the most time sitting. Our findings indicate that effective interventions need to be placed within the study domain with greater emphasis on the classroom.

Participants reported that having access to a recreational facility aided in their ability to live a less sedentary lifestyle. This is intriguing because, although it was defined on the questionnaire they completed, it raises the question of whether the participants understood/understand the distinction between sedentary behavior and physical inactivity. This is concerning if participants view sedentary behavior as lacking in physical activity given previous research (14) demonstrated that 6 to 7 hours of sitting time can negate the effects of an hour of exercise. Thus, access to a gym on its own should not be considered the sole variable for assisting an undergraduate student to live a less sedentary lifestyle, but it certainly helps.

The types of jobs students work while they are in school or during the summers were reported as being mostly jobs where employees are required to be on their feet. The results of the current study did not show much of a disparity between the total sitting time of a student who works a part-time job (11.84 hours/day) versus a student who is unemployed (11.86 hours/day). These results conflict with what we would expect based on the nature of student jobs and this finding may be a product of our study's limitation of the low sample size.

The third facilitator identified by students was walking to and on campus. An Undergraduate University Student Survey conducted by Prairie Research Associates (23) found that 22% of students used walking as their main mode of transportation to campus with about half living within a 20 minute commute of the campus. Students are less likely to walk to campus as they continue into the upper years of study because after the first year of study, students tend to move out of on-campus residences and into off-campus residences (23). Logically, the further students live from campus the less likely they are to walk and turn to modes of transportation such as public transit. Twenty-six percent of students surveyed used public transportation and according to Ly (16) this does not necessarily mean that students who used public transportation are not active compared to those students who do not. Students often have to walk from their homes to the bus stop and then again from the bus stop to the building on campus where a lecture is being held. Ly (16) found that when students are provided with discounted transit passes they may increase their physical activity levels during their daily commutes.

Students identified that a major barrier to them engaging in a less sedentary lifestyle is the amount of sitting they do when in class. This is a difficult barrier to address because students have no control over the environment on campus. Ideally, students would have the choice to sit or stand during lectures. While the retrofitting of an entire existing lecture hall to contain sit-stand desks would likely be expensive, it may provide substantial benefits, and as such, is recommended as a focus for future study. The average daily time spent sitting during study was 2.7 hours a day - making this the highest sedentary domain where an effective intervention has the potential for big change. However, this change also needs to occur outside of the classroom.

The second barrier identified by students was sitting while studying outside the classroom. Unlike the first barrier, students have some control over the study environment at home. However some student responses suggested that the students do not feel that some studying and computer use is possible in a standing position. Some respondents indicated that studying requires sitting. This perception may be changed with greater promotion of sit-stand desks at home. Hedge and Ray (11) found that when employees were given a sit-stand workstation the employees increased the amount of time they spent standing from 8.3% to 21.2% of their workday. This decrease in sitting time resulted in a 27.5% decrease in musculoskeletal discomfort. Not all students can afford a sit-stand desk. For those who cannot afford to have a sit-stand desk or are not interested in purchasing one, promoting the importance of taking breaks from sitting during study is critical.

The greatest limitation faced by the current study is the low number of participants included in the quantitative data analysis. We attempted to obtain an accurate estimate of the total daily sedentary time that was generalizable to the entire undergraduate population but due to the recruitment limitations imposed by the host institution's Office of Research Ethics (i.e., in-person recruitment during a break or end of class when professors had left the room, no posting on course websites, no email recruitment), this was challenging. Despite our best efforts to recruit from multiple faculties, the majority of our participants were recruited from the Faculty of Health Sciences, which is concerning with regard to self-selection bias. Health Science students may have been aware of the dangers of sedentary behavior and may have skewed the data toward lower than accurate sedentary times.

Another limitation was the use of the SIT-Q (17), which is an adequate tool for measuring the sedentary behavior of a general population, but seemed less suitable for undergraduate students in retrospect. As mentioned earlier, the SIT-Q may have greatly under-calculated the total daily time a student sits during study because it is a past-year measure and does not focus on the approximately eight months a student spends in school. In addition, 42 students had to be excluded from data analysis and it is estimated that a proportion of these exclusions were due to students double-counting their sedentary time and thus resulting in implausible sitting times (e.g., counted time sitting to eat AND time sitting to watch television separately, although it is plausible some students sat to watch television while eating). The current study may have found greater success if double counting could have been avoided in the design of the questionnaire. Finally, the creators' instructions (17) stated that a blank space was to be counted as a "0" and assumed that the question asked did not apply to the participant. However, this made it difficult to determine whether a student had left a question blank because it did not apply to them or if they chose to stop answering questions.

A much more accurate method of measuring any individuals sedentary time is the use of an inclinometer and accelerometer (2). With these tools a researcher is able to accurately collect information on energy expenditure as well as posture. When analyzing the responses of a sedentary behavior questionnaire, the only information a researcher is able to collect is whether or not the individual was sitting during a task. According to the study completed by Mansoubi et al. (18), it is possible for certain individuals to expend less than 1.5 METs when standing. With the information collected from the SIT-Q, it is possible that an individual did not provide any information within a certain domain because they stand for that certain task, and therefore lowered their reported total sedentary time. However, when considering the work of Mansoubi et al. (18) and the individual's personal characteristics, the time spent standing could be sedentary time. Although not fiscally possible for the current study, future research to capture a more detailed and accurate picture of the total sedentary time of the undergraduate population would benefit from the use of inclinometers and accelerometers.

Despite the limitations noted above, this study makes some important contributions to the sedentary behavior literature. To our knowledge, this is the first study completed in Canada to investigate the sedentary behavior of university students across different faculties and years of

enrollment. In addition, this is the first study to collect qualitative data on students' perceptions of facilitators and barriers to their sedentary behavior, and these insights can be utilized in future sedentary behavior interventions. The results from this study provide a baseline for future research on the sedentary behavior of undergraduate students. Although the findings suggest that undergraduate students are highly sedentary and a substantial amount of that time is dedicated to study in and out of the classroom, additional research is needed to accurately determine sedentary time that can be generalizable to the entire undergraduate population.

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