Sedentary Behavior in Honors College Freshmen

A Senior Honors Thesis

Submitted in Partial Fulfillment of the Requirements for Graduation in the Honors College

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Abstract

Introduction: Sedentary behaviors (SB) are sitting/reclining activities requiring low energy expenditure such as watching television, reading and desk work. The average person spends eight hours sitting per weekday. Current literature suggests SB may contribute to the development of risk factors for metabolic and cardiovascular diseases. The first year of college is a transition period for freshmen as it provides a new level of independence and freedom to determine how they spend their time. Therefore it is of particular interest to determine their time spent engaging in SB as their life time habits become established. Purpose: To examine the amount of time college freshmen spend various SB. Methods: College freshmen completed The Patient-centered Assessment and Counseling for Exercise Sedentary Behaviors Questionnaire (PACE-SBQ) and a demographic questionnaire. The PACE-SBQ estimated time spent in nine SB on a typical weekday (WD) and weekend day (WED). Participant data was examined by WD and WED and gender by using paired sample t-tests, and independent sample t-test. Descriptive statistics are presented means ± standard deviations. Results: There were sixty participants in the study (17 males and 43 females; 18.1±0.3 yrs; 93.3% Caucasian). Students spent the most time engaged in deskwork (WD: 2.15±1.22 hr/d, WED: 2.25±1.50 hr/d), watching TV (WD: 1.14±1.22 hr/d, WED: 2.11±1.50hr/d), and listening to music (WD: 1.29±1.30 hr/d, WED: 1.44 ± 1.40 hr/d). There was a significant difference in time spent in total SB on a WD (6.42±2.95 hr/d) compared to a WED [(7.98±3.62 hr/d), t (59) =-3.774, p<.0005] for the entire group. On a WD men spent significantly more time (0.56±0.38 hr/d) compared to women [0.16±0.40 hr/d; t(30.83)= 3.58, p=.001] playing computer/video games. Similarly on a WED, men spent significantly more time (0.97±0.81 hr/d) compared to women [0.24±5.1 hr/d; t(19.66)=3.56, p=.003] playing computer/video games. There was statistically significant difference in time spent doing artwork/crafts on a WED for males (0.00±0.00 hr/d) and females [0.11±0.28; t(41.0)=2.51, p=.016].Conclusion: College students engaged in 6-8 hrs/d of SB with the most time spent engaged in desk works, TV viewing and listening to music. College freshmen were sedentary for approximately two hrs/d more on a WED compared to a WD. It is important to address the trends in SB in order to create interventions to prevent negative life-long habits from forming.
Introduction

There are many changes that occur as someone transitions from high school to college. One of the most significant changes is the increase in freedom to make decisions independent from parental influence. This transition period is a time for habit formation that has the potential to have a life-long impact. There are many habits that can form during the downtime between classes and studying. Students can choose to fill that time by being sedentary or physically active. Both which can have lifelong negative and positive influence on health. Therefore it is of interest to study how college freshmen choose to spend their time. There are many detrimental effects of high levels of SB that may have a negative impact on the health of students.

Transition to College

The first year of college is a critical transition period for freshmen. Students experience a drastic change in environment and new freedoms that can contribute to changes in behaviors. According to Hicks and Heastie (2008), “Life transitions, such as moving away from home to college, create valuable opportunities for growth and change while also potentially heightening self-doubt and disappointment, and even encouraging self-defeating habits”. In addition to the new social challenges, students are faced with more demanding academics. Due to these changes freshmen must find balance with their new found freedom and responsibilities. This transition period is an opportunity for personal discovery leading to endless opportunities and decisions to be made independent of parental influence.

The transition from high school to college presents a time of uncertainty. Students now have more independence but also greater responsibility. The start of a new phase of life gives students the opportunity to reinvent themselves. It is a period of growth and identity formation (Hicks and Heastie, 2008). Friends play a large role in identity formation. Friends provide support to the individual and share in new experiences. Freshmen are faced with the situation of leaving old friends and the opportunity to make new friends. Their whole social world is evolving. It is psychologically stressful for freshmen to start over new because of the uncertainty associated with it. There is a fixation on whether or not they will be able to make new friends. Acceptance by others during a time of identity formation has the potential to have profound impact on self-esteem (Hicks and Heastie, 2008). New psychological stress challenges student’s coping mechanisms.

Apart from social and academic choices students are also presented with the freedom to make decisions regarding their diet, physical activity (PA), and sleep patterns. Their decisions regarding these behaviors have the potential to impact their health long term. A study conducted by Wengreen and Moncur (2009) evaluated the changes in weight, body mass index (BMI), diet, and PA during the first semester of college. It was reported that 23% of participants gained ≥ 5% of their baseline body weight during the first semester of college; an average weight gain 4.5 kg. This group also reported that they were less physically active in college when compared to
high school, were more likely to eat breakfast regularly (at least four times a week), and reported less hours of sleep per night (7.38±2.24 hrs) (Wengreen and Moncur, 2009). Freshmen who live on campus are often required to purchase a meal plan from the college. These meal plans usually include all you can eat style dining halls. The transition from family style dinner at home to buffet style dining at college presents a new variety and increased volume of food. It has been hypothesized that eating at dining halls presents a significant risk for weight gain during the transition from high school to college. The greater variety and abundance of food promotes eating above caloric needs (Wengreen and Moncur, 2009). The combination of increased caloric intake from the new eating environment and decreased caloric expenditure from a reduction in PA can have negative implications on physical and mental health. During this critical transition period freshmen are given new found freedom, control and an abundance of options.

**Habit Formation**

Habit formation requires a sense of autonomy; the student must decide for themselves. During the transition from high school to college students face a new sense of freedom that requires adjustment. It is critical that during this transition period students realize a changed environment often leads to a change in habit and presents the new opportunity for habit formation. The major areas of habit formation for freshmen at this time include diet, sleep, PA, SB and study habits. The process of habit formation follows and asymptotic pattern; it is the relationship between repetition and automaticity. Lally and Gardner (2013) describe the asymptotic pattern, “initial repetitions caused a large increase in automaticity, but with each new repetition, automaticity gains reduced until the behavior reached its limit of automaticity” (p. S141). It has been found that it take on average 66 days for an action to develop into a habit. During the first two months of college habits are formed.

![Figure 1. Habit formation following an asymptotic curve. Adapted from “Promoting habit formation,” by P. Lally and B. Gardner, 2013, Health Psychology Review, 7, p. S141. Copyright 2013 by Taylor and Francis Group.](image-url)
The period of transition from high school to college presents an environmental change. A change in environment has the potential to influence current habits and to contribute to the development of new habits. Lally and Gardner (2013) have defined a habit as, “automatic behavioral responses to environmental cues, thought to develop through repetition of behavior in consistent contexts”. Behavior change strategies that aim to break bad habits suggest taking the person out of the environment in which the habit is performed (Lally and Gardner, 2013). The transition from high school to college is a forced behavior change due to the abrupt change in environment. For example, a student who previously was a member of a sport team in high school regularly engaged in PA; therefore facilitating a habit of regular PA participation. During the transition to college the student may no longer be on a sport team and is therefore no longer in an environment that necessitates regular PA. The student broke their habit of PA from high school and now must how to incorporate PA in their life. According to Lally and Gardner (2013) there are four steps to habit formation:

1. A decision must be made to take action.
2. The decision to act must be translated into action.
3. The behavior must be repeated.
4. The new action must be repeated in a fashion conducive to the development of automaticity.

The transition from high school to college creates a period of uncertainty with changes and the development of new habits due to the change in environment and gained sense of autonomy. During this critical period habit formation has the potential to effect the student for the rest of their life. Many habits in regard to SB, PA, sleep and diet are developed at this time and have the potential to both positivity and negatively effect health. It is pertinent to encourage positive habit formation during this time of uncertainty and development.

**Physical Activity**

Physical activity (PA) is an activity that requires skeletal muscle contraction above resting energy expenditure, 3.0 METs or greater. The American College of Sports Medicine (ACSM) recommends 150 minutes of moderate physical activity (ie. walking at brisk pace, vacuuming and mowing the lawn) or 75 minutes of vigorous physical activity (ie. jogging/running, shoveling, and swimming) week; or a combination of the two (Pescatello et al., 2014). Physical activity presents many health benefits including the prevention of chronic diseases such as cardiovascular disease, certain types of cancer, type II diabetes and obesity. It also helps with long term weight control and can help to reduce the symptoms related to depression (Miller et. al, 2005). Some of the mechanisms for the protective effect of PA include
increased oxygen supply to the myocardium and improved myocardial contraction, lower blood pressure, improved lipoprotein profile and increased insulin sensitivity (Page et. al, 2015). Bray and Born (2004) followed students during their last two months of high school to their first two months at college. It was reported that 66.2% of students were classified as active during the last two months of high school compared to 44.1% of students during the first two months of college. Bray and Born (2004) reported that 39% of men and 35% of women aged 18-24 met the ACSM recommendations for PA. This evidence suggests a decline in PA during the transition from high school to college. A longitudinal study conducted by Gordon-Larsen et. al (2004) followed subjects from childhood to young adulthood found that the (61%) of males and females did not achieve 5 or more bouts of moderate to vigorous PA in both adolescence and adulthood. Of subjects who did achieve 5 or more sessions of PA during adolescence, one third (31.1%) failed to achieve the recommended level of PA in young adulthood (Gordon-Larsen et al., 2004). These results suggest that being physically active in adolescence is not enough in continuing PA into adulthood. The decline is PA as people transcend through adolescents to young adulthood has the potential to impact the development of health habits. A lack or decline of PA coincides with a decline in the protective health benefits associated with PA.

Sedentary Behavior

Sedentary behavior and lack of physical activity, not meeting the ACSM recommendations for PA, are often looked at as one in the same. Sedentary behavior (SB) is defined as any activity done while sitting or in a reclined position requiring 1.0-1.5 METs (Tremblay et al., 2010). Examples of SB include watching television, working on the computer and driving during the commute to work. Many studies categorize subjects as sedentary based on not meeting PA guidelines. The conclusions drawn from these studies thus make implications on the lack of PA rather than the accumulation of SB. A more direct measure of SB and a holistic approach to total daily energy expenditure has the potential to identify the risks of SB independent of PA (Russel et al., 2008). Everyday life presents a variety of activities resulting in a range of energy expenditure. A movement continuum represents the relationship between sedentary behavior and physical activity (Tremblay et al., 2010). The continuum depicts the transition in energy expenditure from sleep to intense exercise (Refer to Figure 2.). Sleep represents the SB extreme and intense exercise represents (ie. R)unning at 7 mph, digging ditches, and playing competitive soccer) the PA extreme. A phenomenon known as the Active Couch Potato demonstrates that a person can be at both ends of the spectrum in one day (Owen et al., 2010). A person can meet the ACSM recommendations for PA while in the same day log many hours of SB. Russell et al. (2008) measured SB and PA using accelerometry. They compared Subject 1 who did not meet PA guidelines but spent most of their day engaged in light PA (75% of their day) to Subject 2 who met the recommendations for PA but spent the majority of their day engaged in SB (70% of their day). Subject 1 logged 26.3 MET-hours for the day compared to Subject 2 who logged 23.6 MET-hours. The comparison of total MET-hours
exemplifies the concept of the Active Couch Potato. Sedentary behavior and physical activity can exist independently of each other and also have the potential to co-exist.

![Figure 2. The movement continuum, illustrating the different focus of sedentary physiology and exercise physiology. METs, metabolic equivalent tasks. Adapted from “Physiological and health implications of a sedentary lifestyle”, by M.S. Tremblay et. al., 2010, Applied Physiology, Nutrition, and Metabolism, 35, p. 726. Copyright 2010 by the NRC Research Press.](image)

College students spend many hours sitting in class and labs. The typical duration of class is 50-75 minutes and a typical lab 2-3 hours. The accumulation of time in SB can take a negative effect on the body. Thorp et al. (2009) studied overall daily sitting time; SB was not constrained to only leisure time. In men and women the following biomarkers were detrimentally associated with sitting time: waist circumference, body mass index (BMI), systolic blood pressure, fasting serum triglycerides, HDL-cholesterol, fasting serum insulin. Sitting time in women was specifically associated with higher BMI and higher systolic blood pressure (Thorp et al., 2009). Multiple studies have found that SB may cause increased triglyceride levels, decreased levels of high-density lipoprotein cholesterol, and decreased insulin sensitivity. Adverse alteration in these metabolic markers can indicate the presence risk factors for obesity, type II diabetes, cardiovascular disease (CVD), and certain types of cancer in those ≥ 18 years of age (Koster et al., 2012). Certain types of cancer have been associated with SB. Tremblay et al. (2010) reported that high levels of television viewing were associated with increased risk of colon cancer in men and endometrial cancer in women. The leading cause of death in the USA and Europe is CVD (Healy et al. 2011). SB has detrimental effects on the biomarkers that indicate increase risk for CVD. Healy et al.(2011) discuss the importance of breaking up SB. SB has been beneficial associated with adiposity, triglycerides, and 2 hour fasting glucose independent of total SB and PA. Prolonged hours of SB have a more profound impact on biomarkers associated with disease. Using acclerometry it was determined that women spend more time sedentary but had more breaks in SB which coincided with a more-favorable cardio-metabolic profile than men. The length and intensity of breaks were not identified and breaks a short as one minute were not directly measured (Healy et al. (2011). The breaks therefore were not necessarily PA but still had a positive impact on the ill effects of prolonged SB. It is important to determine the trends in prolonged SB because interventions that involve short breaks in SB can help have a positive impact on the risks associated with CVD, obesity, and metabolic diseases.
Behavior Choice

During free time between classes and studying students have the choice to either be sedentary or physically active. Epstein and Roemmich (2001) researched the factors that go into choosing between SB and PA. The factors that impact behavior choice include accessibility and reinforcing value. Access to either SB or PA can be environmental access and also includes the work or energy necessary to perform the behavior. Reinforcing value of the behavior is the motivation to engage in the activity. Figure 3. depicts the process of behavioral choice. Epstein and Roemmich (2001) found in situations that accessibility was equal for both PA and SB people choose to engage in the more reinforcing activity. Similarly, when the reinforcing value of PA and SB are equal people choose to engage in the most accessible activity. Epstein and Roemmich (2001) state that a main reason people choose SB over PA is because SB is more accessible and PA requires more work to engage in. Apart from the physical work PA involved changing clothes, sweating, and discomfort. There is an added cost associated with PA when compared to SB. Another influence on behavior choice is changing the access or options available. Behaviors can be related as substitutes, complements, or exist independently of each other. Examples provided by Epstein and Roemmich include:

- Substitution: An individual usual runs outside but there are poor weather conditions; the individual chooses to instead ride a stationary bike or swim indoors.
- Complements: Eating and watching television usual occur in the same setting.
- Independent: Changes in one behavior do not influence the other behaviors.

The perceived outcome of the activity also has an important factor in behavioral choice. Sedentary behavior is often associated with an immediate benefit; enjoyment or relaxation. Physical activity is oppositely often associated with delayed outcome; health benefits. Epstein and Roemmich (2001) state there are large differences in people who have poor impulse control and are more likely to choose the SB as opposed to individuals with the ability to delay gratification and choose the PA. The delayed outcome of PA makes SB more appealing in the immediate time frame.
Engaging in PA usually involves choosing exercise over the concurrent and competing SB. This decision is based on environmental factors, including differences in access, availability (number and type of physically active and sedentary alternatives), reinforcing value (motivation to engage in the activities), and the timing of access to physically active and sedentary alternatives. Environmental factors are filtered through individual differences in impulsivity, which can be conceptualized as the preference for smaller immediate rewards (SB) over larger delayed rewards (improved adiposity and later health benefits through exercise) and how sensitive people are to reinforcers. The combination of environmental factors and individual differences results in a choice of engaging in either PA or SB. When choosing PA, SB are reduced because they are replaced by PA and eating and energy intake is reduced due to fewer opportunities to eat. Choosing PA ultimately results in reduced adiposity, Choosing SB results in increased eating and food intake due to the complementary nature of these behaviors, and PA is reduced while adiposity increases. Adapted from “Reducing sedentary behavior: Role in modifying physical activity,” by L. Epstein and J.N. Roemmich, 2001, Exercise and Sports Sciences Reviews, 29, p. 104. Copyright 2001 by the American College of Sports Medicine.

Epstein and Roemmich (2001) examined the behavior choice of male college students in a laboratory setting. They manipulated the access of SB and PA to explore the role of environmental access in behavior choice. Subjects were assigned to groups in which PA or SB were located either near or far (5 minute walk away) from the person. The results of Epstein and Roemmich (2001) found that subjects participated in which ever activity was near; if SB were
near subjects engaged in SB alternatively if PA was near subjects engaged in PA. The results of this study showed the impact on accessibility and environment on behavior choice between PA and SB. Epstein and Roemmich (2001) concluded that the results made implications that if environments were changed to increase access to PA and decrease access to SB, the choice to engage in PA would be more supported.

Sedentary behavior and PA can be observed in the occupational, leisure, household, and transportation domains. Figure 4 describes the behaviors choices between SB and PA that occur in the various domains. People are in settings where they sit all day. Many hours are logged in front of computers at desks, during the commute to work, and relaxing at the end of the day in front of the television. The environment can act in a way that constrains the behavioral choice. As Epstein and Roemmich concluded behavior choice can be dependent on the accessibility of activities provided by the environment. The domains of activity look at a complete view of daily energy expenditure as opposed to energy expenditure during regimented exercise. Owen et al. (2000) discussed the effect of environmental setting on behavior choice. The environment can act as a barrier or a facilitator to activity. For example, a town that has many parks and bike paths can act as a facilitative environment for PA. Oppositely, the occupational world acts as a facilitator for SB. The occupational world has become increasingly sedentary with advances in technology taking away the physical demand of jobs. The work force almost necessitates sitting at a desk for long periods of time. A societal shift towards creating environments with increased access to PA would in turn help to create a decrease in SB by substitution of the behavior (Owen et al. 2000).
Figure 4. Potential influences of behavior settings and their function on examples of physically active and sedentary choices. Adapted from “Environmental Determinants of physical activity and sedentary behavior”, by N. Owen et al., 2000, Exercise and Sport Sciences Reviews, 28, p.155. Copyright 2000 by the American College of Sport Medicine.

In summary, the first year of college is a transition period for freshmen as it provides a new level of independence and freedom to determine how they spend their time. The changes students experience may be academic, social, physical, and emotional. Freshmen are free from the structure of their high schools and home environments and are now faced with new decisions to make on their own. The average college student gets about 6-7 hours of sleep per night (Tsai et al., 2003). Leaving approximately 17-18 hours of the day to be used determining what to eat, how to spend down time either engaged in PA or SB. The decisions freshmen make during this time in their life will help to establish habits that can last a lifetime. Therefore this transition period plays an integral part in the development of both healthy PA and detrimental SB habits and is therefore of particular interest to study.

Purpose:

The purpose of this study was to examine the amount of time college freshmen spend engaged in various SB.
Methods:

This was a cross sectional study, designed to examine the amount of time spent in a variety of SB. Freshmen participants from the College at Brockport Honors College peer mentor program were recruited as participants. Interested participants were given a brief description of the study and a statement of informed consent; approved by the University’s Institutional Review Board. The eligible participants completed the Patient-centered Assessment and Counseling for Exercise Sedentary Behaviors Questionnaire (PACE-SBQ) and a demographic questionnaire.

Participants

Seventy one participants were initially recruited and sixty eligible participants completed the study (17 males and 43 females; 18.1±0.3yrs; 93.3% Caucasian). Eligible students had to be at least 18 years old in order to have the ability to make an informed decision and sign the informed consent. Only participants that fully completed the PACE-SBQ and demographic questionnaires were included in the study. The participants represented the five schools of the college in addition to an undeclared/double major group. The five schools included: The Arts, Humanities and Social Sciences, Education and Human Services, Health and Human Performance, Business Administration and Economic, and Science and Mathematics. The school of Health and Human performance represented 43.3% of the sample. For further information about the representation of the schools of the college refer to Table 1.

Table 1. Participant Representation Across the College

<table>
<thead>
<tr>
<th>School</th>
<th>Percentage (%)</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The School of Arts, Humanities, and Social Sciences</td>
<td>10</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>The School of Education and Human Services</td>
<td>1.7</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>The School of Health and Human Performance</td>
<td>43.3</td>
<td>26.9</td>
<td>73.1</td>
</tr>
<tr>
<td>The School of Business Administration and Economics</td>
<td>8.3</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>The School of Science and Mathematics</td>
<td>21.7</td>
<td>53.8</td>
<td>46.2</td>
</tr>
<tr>
<td>Undeclared/Double Major</td>
<td>15</td>
<td>11.1</td>
<td>88.8</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>28.3</td>
<td>71.7</td>
</tr>
</tbody>
</table>
Questionnaires

The participants completed a demographic questionnaire that asked questions about gender, ethnicity, and anticipated major. The participants were provided with verbal instructions for the completion of the PACE-SBQ questionnaire. This questionnaire instructs the participants to estimate how much time (none, 15 min or less, 30 min, 1hr, 2 hrs, 3 hrs, 4 hrs, 5 hrs, 6 hrs or more) they spend in a variety of SB. These SB include: watching television, playing computer or video games, listening to music, talking on the phone, doing desk work, reading, playing a musical instrument, doing artwork or crafts, and sitting or driving in a car, bus, or train. PACE-SBQ looks at a typical weekday (WD) and a typical weekend day (WED). An example of the demographic questionnaire and the PACE-SBQ is located in Appendix A.

Data Analysis

Participant data was examined by WD and WED and gender by using paired sample t-tests and independent t-tests. P value was set at <.05 apriori. Descriptive statistics are presented means ± standard deviations. Statistical tests were run using IBM SPSS Statistics 23.

Results

Most Engaged in Sedentary Behaviors

Figure 4. Sedentary Behaviors of Honors College Freshmen
Students spent the most time (hr/d) doing deskwork (WD: 2.15±1.22 hr/d, WED: 2.25±1.50 hr/d), watching TV (WD: 1.14±1.22 hr/d, WED: 2.11±1.50 hr/d), and listening to music (WD: 1.29±1.30 hr/d, WED: 1.44±1.40 hr/d) (Refer to Figure 4).

**Total Sedentary Behavior**

A paired sample t-test was conducted to compare the total time spent in SB on a WD and WED. There was a statistically significant difference in total time spent in SB on a [WD (6.42±2.95 hr/d) to SB on a WED (7.98±3.62 hr/d), t(59)=-3.774, p<.0005]. These results suggest that students engage in more SB on a WED when compared to a WD (Refer to Figure 5.).
**Gender Differences**

**Table 2. Time Spent in Various Sedentary Behaviors on a Weekday**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Females</th>
<th>Males</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching TV</td>
<td>1.06</td>
<td>1.34</td>
<td>0.737</td>
<td>26.303</td>
</tr>
<tr>
<td></td>
<td>(1.343)</td>
<td>(1.179)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing Computer or Video Games</td>
<td>0.16</td>
<td>0.56</td>
<td>3.579*</td>
<td>30.831</td>
</tr>
<tr>
<td></td>
<td>(0.400)</td>
<td>(0.380)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listening to Music</td>
<td>1.41</td>
<td>0.99</td>
<td>-1.292</td>
<td>39.658</td>
</tr>
<tr>
<td></td>
<td>(1.388)</td>
<td>(1.025)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On the Phone</td>
<td>0.59</td>
<td>0.29</td>
<td>-1.843</td>
<td>57.430</td>
</tr>
<tr>
<td></td>
<td>(0.932)</td>
<td>(0.322)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing Deskwork</td>
<td>2.20</td>
<td>2.00</td>
<td>-0.635</td>
<td>35.840</td>
</tr>
<tr>
<td></td>
<td>(1.282)</td>
<td>(1.046)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td>0.8</td>
<td>0.59</td>
<td>-1.096</td>
<td>33.238</td>
</tr>
<tr>
<td></td>
<td>(0.745)</td>
<td>0.655</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing an Instrument</td>
<td>0.1</td>
<td>0.22</td>
<td>1.125</td>
<td>25.500</td>
</tr>
<tr>
<td></td>
<td>(0.332)</td>
<td>(0.394)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing Artwork or Crafts</td>
<td>0.09</td>
<td>0.09</td>
<td>-0.063</td>
<td>30.281</td>
</tr>
<tr>
<td></td>
<td>(0.273)</td>
<td>(0.264)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driving</td>
<td>0.10</td>
<td>0.06</td>
<td>-1.164</td>
<td>50.08</td>
</tr>
<tr>
<td></td>
<td>(0.191)</td>
<td>(0.109)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. *p≤.05. Standard Deviations appear in parentheses below means.*
Table 3. Time Spent in Various Sedentary Behaviors on a Weekend Day

<table>
<thead>
<tr>
<th>Gender</th>
<th>Females</th>
<th>Males</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching TV</td>
<td>2.2</td>
<td>1.88</td>
<td>-0.685</td>
<td>24.456</td>
</tr>
<tr>
<td></td>
<td>(1.456)</td>
<td>(1.648)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing Computer or Video Games</td>
<td>0.24</td>
<td>0.97</td>
<td>3.356*</td>
<td>19.657</td>
</tr>
<tr>
<td></td>
<td>(0.505)</td>
<td>(0.806)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listening to Music</td>
<td>1.51</td>
<td>1.25</td>
<td>-0.704</td>
<td>34.498</td>
</tr>
<tr>
<td></td>
<td>(1.491)</td>
<td>(1.169)</td>
<td></td>
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</tr>
<tr>
<td>On the Phone</td>
<td>0.67</td>
<td>0.63</td>
<td>-0.242</td>
<td>32.277</td>
</tr>
<tr>
<td></td>
<td>(0.756)</td>
<td>(0.632)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing Deskwork</td>
<td>2.3</td>
<td>2.11</td>
<td>-0.518</td>
<td>43.252</td>
</tr>
<tr>
<td></td>
<td>(1.652)</td>
<td>(1.037)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td>0.78</td>
<td>0.72</td>
<td>-0.262</td>
<td>32.528</td>
</tr>
<tr>
<td></td>
<td>(0.899)</td>
<td>(0.747)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing an Instrument</td>
<td>0.1</td>
<td>0.27</td>
<td>1.113</td>
<td>19.39</td>
</tr>
<tr>
<td></td>
<td>(0.349)</td>
<td>(0.574)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing Artwork or Crafts</td>
<td>0.11</td>
<td>0.00</td>
<td>-2.508*</td>
<td>41.00</td>
</tr>
<tr>
<td></td>
<td>(0.277)</td>
<td>(0.00)</td>
<td></td>
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</tr>
<tr>
<td>Driving</td>
<td>0.39</td>
<td>0.36</td>
<td>-0.201</td>
<td>37.458</td>
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<tr>
<td></td>
<td>(0.577)</td>
<td>(0.418)</td>
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</table>

Note. *p≤.05. Standard Deviations appear in parentheses below means.
An independent sample t-test was conducted to compare time spent in the various SB for males and females. There was a statistically significant difference for time spent playing computer or video games on a WD for males (0.56±0.38 hr/d) and females [0.16±0.40 hr/d; t(30.83)= 3.58, p=.001]. Similarly on a WED there was a statistically significant difference for time spent playing computer or video games for males (0.97±0.81 hr/d) and females [0.24±5.1 hr/d; t(19.66)=3.56, p=.003]. On both a WD and WED men spent more time (WD≈25 min, WED≈45 min) playing computer or video games than women. There was also a statistically significant difference in time spent doing artwork or crafts on a WED for males (0.00±0.00 hr/d) and females [0.11±0.28; t(41.0)=-2.51, p=.016]. Women spent more time (≈ 10 min) doing artwork or crafting than men on a WED. There were no statically significant differences in the remaining SB behaviors on a WD or WED between males and females (Refer to Table 2., Table 3. and Figure 6.).

Discussion:

Most Engaged in Sedentary Behaviors

Honors College freshmen spend the most time engaged in desk work, TV viewing, and listening to music. Comparatively adults spend the most time engaged in TV viewing, sitting socializing and reading (Owens et al., 2003). College freshmen spend 1-2 hrs/d watching TV similarly adults watch 1.5-2 hrs/d (Owens et al., 2003). Television viewing has been the primary SB addressed when examining the impact of SB on health. TV viewing in adults has been associated with psychosocial outcomes. Research found that adults watching TV more than 42
hrs/wk (≈6 hrs/d) had 31% greater chance of developing a mental disorder than those who reported watching TV less than 10.5 hrs/wk (≈1.5 hrs/d) (Tremblay et al.; 2010). TV viewing has been detrimentally associated with weight gain, type II diabetes, some cancers, abnormal glucose metabolism, metabolic syndrome, and risk factors for cardiovascular disease (Dunstan et al., 2010). In a study conducted by Dunstan et al. (2010) subjects participated in at home interview collecting information on health history and television viewing, a biomedical exam looking at biomarkers, and a mortality follow-up. It was determined that each one hour of television watched was associated with an 11% increased risk of all-cause mortality and a 18% increased risk of CVD mortality (Dunstan et al., 2010). In a comparison between subjects who watched less than two hours per day of TV compared to subjects who watched greater than four hours per day, the group logging more hours of television had a 46% increased risk of all-cause mortality and 80% increased risk of CVD mortality (Dunstan et al., 2010). Hadgraft et al. (2015) described a positive association between BMI and high levels of TV viewing. This may be due in part to the additional association between high levels of TV viewing and the greater consumption of energy snack food. The consumption of these foods increases the risk of obesity (Hadgraft et al., 2015). Wilmont et al. (2012) found that prolonged sitting time had an impact on insulin resistance and glycaemia. The impact on these physiological mechanisms is linked to the risk of developing Type II diabetes. Increased risk of type II diabetes has been associated with TV viewing because of its impact on glycolytic markers. Dunstan et al. (2007) found that for each one hour per day increase in television viewing fasting plasma glucose increased by 0.02 mmol/l in men and 0.04 in women. The corresponding increase in two hour postchallenge glucose (2-h PG) was 0.11 mmol/l in men and 0.16 mmol/l in women (Dunstan et al., 2007). Television viewing time was more positively associated with 2-h PG. Dunstan et al. (2007) suggest that SB contributes to reduce in glucose disposal in the tissues. SB requires minimal skeletal muscle contraction and thus decreased clearance of glucose from the plasma (Dunstan et al., 2007). The decrease in skeletal muscle contraction impacts how glucose is used in the body. High levels of media exposure have also been correlated with increased aggression, lower self-esteem, and decreased prosocial behavior (Tremblay et al.; 2010). In addition to the negative physical effects of logging many hours sitting and watching TV the content of TV and media exposure have a negative effect on mental health.

Owens et al. (2003) reported that the third most engaged in SB by adults was reading (Men: 42.6±44.4 min/d, Women: 40.2±45.6 min/d). College freshmen spend a similar amount of time reading compared to adults (WD: Men: 35.29±39.31 min/d, Women: 48.14±44.71 min/d; WED: Men: 43.13±44.79 min/d, Women: 46.76±53.95 min/d). In both adults and college students women spend more time reading than men. Owens et al. (2003) found significant effects for time spent reading by age (F(3, 1271)=3.7, p<.01). Subjects who were 60 years or older spent approximately 54 minutes per day reading whereas subjects age 18-30 engaged in approximately 35 minutes per day (Owens et al., 2003). Honors college students logged 77.25 ± 78.0 min/d and 86.38± 84.26 min/d listening to music on a WD and WED respectively. Owens et al. (2003) reported that subjects aged 18-30 listened to music for approximately 33 min/day. There an
approximate difference of 44-53 min/day between Honors College Freshman and the adult population of the study conducted by Owens et al. This difference may be due to the difference in lifestyle from the college life to the working world. It can be hypothesized that the preference in preferred SB changes overtime. The top three SB reported for Honors College freshmen were desk work, TV viewing, and listening to music. The top three SB reported by adults aged 31 to greater than 60 years old were TV viewing, sitting and socializing and reading (Owens et al, 2003). Students have heavy course loads that require deskwork. Necessity and preference may have an impact on the most engaged in SB.

Total Sedentary Behavior

Honors College Freshmen spend a total of 6-8 hrs/d engaged in SB; this is in addition to the time spent sitting in class because of this the life of a college student is intrinsically sedentary. Due to the traditional lecture format of class with students sitting for 50-75 minutes at a time it is difficult to change the SB accumulated during class time, therefore it is important to examine the SB engaged in outside of class. The sedentary demands of college life can be compared to the similar sedentary demands of adulthood and the work force. Kim et al. (2015) determined using accelerometry that adults (≥18 years of age) spend about 8 hrs/d engaged in SB (Kim et al., 2015). Comparatively Honors Freshmen spend about two hours less on a WD (6.42±2.6 hrs/d) and about equal amount on a WED (7.98±3.6 hrs/d) engaged in SB. Hadgraft et al. (2015) found that mortality risk increased by 5% for each additional hour spent sitting beyond seven hours per day. Both college freshman and adults have reported engaged in approximately seven hours per day of SB not including class time. Similarly to college students who are constrained to be sedentary during school hours adults have a highly sedentary occupational life. In a sample of full-time students (37%) and office workers (63%) a total of 9.0±0.9 hours per day sitting was reported by participants (Barwais et al., 2013). Trembley et al. (2010) determined the risks associated with two hours per day increase in sitting at work. Each 2 hour increase per day in sitting was associated with a 5% increased risk of obesity and 7% increase risk of type II diabetes (Tremblay et al., 2010). Today’s society constrains people to be highly sedentary. The detrimental effects of SB are showing associations with many health risks. A dose-response has been observed between total time engaged in SB and all-cause mortality and CVD-mortality (Tremblay et al., 2010). The more time spent engaged in SB associated with a greater risk of mortality.

Gender Differences

Gender differences were observed between Honors college freshmen in the following SB: WD/WED time spent playing computer/video games and WED time spent doing crafts/artwork. Men spend more time engaged in computer/video games than women on both WD and WED. On a WD men spend about 25 minutes more and on a WED spend about 45 minutes playing computer/video games than women. Owen et al. (2003) found similar differences between adult men and women with regards to computer time. Men spend about 20 min/d where as women
spend about 10 min/d on the computer (Owen et al, 2003). Honors freshmen women spend a significantly greater amount of time (≈10 min) doing crafts/artwork on a WED compared to men. Owen et al. (2003) compared time engaged in a hobby between adult men and women. There was not a significance difference but both men and women spend about 20-25 min/d doing a hobby (Owen et al., 2003). The results from Owen et al. (2003) suggest broadening the category from crafting/artwork to hobbies is more inclusive to both genders.

**Intervention**

College freshmen are going through a transition period full of habit changes and habit formation. It is important to identify how habits are changing. The new sense of independence gives college freshmen the freedom to choose what they do with their time. There is no longer mandated physical education class and sports teams become more selective. It is now up to the student to determine how they spend their time. Engaging in many hours of SB can increase the chances of developing the risk factors associated with CVD, metabolic diseases, type II diabetes, obesity and some types of cancer. It is important to intervene in the accumulation of SB at a younger age in order to stop SB habits from becoming life-long. The goal of interventions for SB is to reduce total sedentary time and too break up long bouts of SB. It has been determined that college freshmen spend significantly more time (≈2hrs) engaged in SB on a WED. An intervention can be put in place to reduce this increase in SB from the WD to WED. Possible interventions include: planning a fun PA each weekend, limiting the time spent watching TV, doing household chores on the weekend. Honors College freshmen engage in deskwork, TV viewing and listening to music the most. These SB are also starting points for an intervention. An intervention that can be used for and SB in to take active breaks from SB; every 30 minutes take a walk. To make TV viewing more active get up to change the channel and/stretch while watching TV. An intervention for listening to music is to make music mobile; use an ipod and go for a walk while listening to music. Owen et al (2011) suggest getting up and standing or moving around after 30 minutes of uninterrupted sedentary time. They also recommend limiting leisure sitting to no more than 2 hours per day. Healy et al. (2011) found that break sin SB were beneficially associated with adiposity, triglycerides, and two hour plasma glucose independent of total SB and PA time. Breaking bouts of SB can help to lessen the negative effects.

**Limitations**

This study presented with some limitations that may have had an effect on the results. In regards to answering the PACE-SBQ questionnaire participants may have intentionally underestimated their answers for fear of being judged. When answering questions in regards to SB there can be a negative connotation involved. The relationship between negative health implications and SB may have cause participants to answer conservatively. Another limitation was the language on the PACE-SBQ. Some of the SB were notated in language that is outdated and may have led to confusion. For example the language used to describe phone use was “sitting and talking on the phone”. This description could have been change to sitting on the
phone texting, talking, and using social media. Including texting and social media would have been more inclusive and addressed a common SB in students. Another limitation is that the answers to the questions rely on recalled information. The participants were asked to think back to the previous week and estimate how much time they spent engaged in SB. This type of answer leaves room for uncertainty. Future studies should examine this behavior using objective measures to more accurately assess time in conjunction with descriptive survey assessments.

Conclusion:

Honor college freshmen experience a period of change, uncertainty, and habit formation as they transition from high school to college. There is a new sense of independence and freedom to make decisions independent of parental influence. Freshmen can choose how they spend their free time; either engaged in PA or SB. Honors college freshmen engaged in 6-8 hrs/d of SB. The most engages in SB include deskwork, TV viewing and listening to music. Many hours engaged in SB are associated with increased risk for the development of obesity, type II diabetes, metabolic diseases, CVD, and certain types of cancer. It is important to identify trends in SB in order to create interventions to prevent negative life-long habits from forming.

Acknowledgments:

Thank you to Dr. Banerjee for her help and guidance with the statistics for this research, Dr. Treadwell for her support and involvement in the research process, and the graduation students, Zachary Ferrara and Kathryn Oaks, for their assistance with data collection.
Appendix A

I. Demographic Questionnaire

Using Photovoice to Understand Influencing Factors of Physical Activity and Sedentary Behaviors in First Semester College Freshmen

DEMOGRAPHIC SHEET

Name________________________  Pseudonym__________________________ ID#________

Email address:______________________________ Cell phone number:____________________

LLC:__________________________________ Anticipated major:_________________________

Age:________________________  Birthdate:_____________________________________

I own a cell phone that has camera capabilities            Yes   No

I am willing to participate in the focus group session       Yes   No   Focus group #_____

I am willing to participate in the Photovoice week            Yes   No

Write your class/work schedule in the following table:

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Background Information
What is your gender? ______________________________

What is your racial background? Please place a Check Mark next to the ones that apply to you.

____ White  ____ Hispanic or Latino  ____ Black or African American

____ Native American or American Indian  ____ Asian / Pacific Islander

____ Other: _________________________________________________________________

My high school was described as (circle one): urban  suburban  rural

The size of my high school was (circle one):

< 1500 students  1000-1500 students  999-500 students  499-200 students

< 200 students

When I was in high school, I attended physical education (circle one): yes  no.

If you answered “yes” to the question above, indicate the number of days per week by circling one of the options below:

1-2 days per wk  2-3 days per wk  3 or more days per wk

Perceptions of High School Physical Education

Please respond to the statements below by circling your preferred response.

I know how to develop an individual fitness program because of my participation in high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I enjoyed participating in the activities we learned in high school physical education class outside of the school day (e.g., team sports, individual sports, etc.)

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I have faked an injury/illness to get out of high school physical education class.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree
I often teased students who I thought were lower-skilled than me in my high school PE class.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I tried harder in activities and sports that I am good at in high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I often tried not to attract attention to myself by other students or my teacher and/or tried not to be noticed in high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

Overall I believe my high school physical education was a positive experience for me.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I understand the importance of a physically active lifestyle as a result of my high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I would rather play team activities than individual activities when I was in high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I was afraid of making mistakes in front of my friends and peers in high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I didn’t mind getting hot and sweaty during high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I thought my high school physical education grade was important.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree
My parents thought my high school physical education grade was important.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

My friends influenced the way I behaved in high school physical education.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

I will be physically active even though I am not required to take any formal physical education in college.

Strongly Agree  Agree  Neither agree nor disagree  Disagree  Strongly Disagree

List your three favorite physical activities to participate in (could be in class or outside of class) during high school:

Overall, I thought high school physical education was enjoyable.

_____YES  _____NO

If you answered yes, list three things you enjoyed most about your high school physical education experience.

If you answered no, list three things you enjoyed least about your high school physical education experience.

Adapted from (Lund & Tannehill, 2010)
### II. PACE-SBQ

#### SEDENTARY BEHAVIOR: Weekday

On a typical WEEKDAY, how much time do you spend (from when you wake up until you go to bed) doing the following?

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>15 min. or less</th>
<th>30 min.</th>
<th>1 hr</th>
<th>2 hrs</th>
<th>3 hrs</th>
<th>4 hrs</th>
<th>5 hrs</th>
<th>6 hrs or more</th>
</tr>
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<tbody>
<tr>
<td>1. Watching television (including videos on VCR/DVD).</td>
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<td>2. Playing computer or video games.</td>
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<td>3. Sitting listening to music on the radio, tapes, or CDs.</td>
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<td>4. Sitting and talking on the phone.</td>
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<td>5. Doing paperwork or computer work (office work, emails, paying bills, etc.)</td>
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<td>7. Playing a musical instrument.</td>
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<td>8. Doing artwork or crafts.</td>
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<td>9. Sitting and driving in a car, bus, or train.</td>
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</table>
### SEDENTARY BEHAVIOR: Weekend Day

On a typical WEEKEND DAY, how much time do you spend (from when you wake up until you go to bed) doing the following?

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>15 min. or less</th>
<th>30 min</th>
<th>1 hr</th>
<th>2 hrs</th>
<th>3 hrs</th>
<th>4 hrs</th>
<th>5 hrs</th>
<th>6 hrs or more</th>
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<tbody>
<tr>
<td>1. Watching television (including videos on VCR/DVD).</td>
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<td>2. Playing computer or video games.</td>
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<td>3. Sitting listening to music on the radio, tapes, or CDs.</td>
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<td>4. Sitting and talking on the phone.</td>
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<td>5. Doing paperwork or computer work (office work, emails, paying bills, etc.)</td>
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<td>7. Playing a musical instrument.</td>
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<td>8. Doing artwork or crafts.</td>
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<td>9. Sitting and driving in a car, bus, or train.</td>
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References


