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Assessing the Impact of Undergraduate College Student Health on Academic Performance Across Academic Year

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Purpose: The transition into college is a life-change event where academic success can be influenced by health. This investigation intended to estimate the prevalence of health impediments to academic performance (HIAP) and proportional differences across academic year. Methods: Sample included U.S. undergraduate, full-time, domestic students (n = 120,434) from NCHA-II2008-2013 data. 30 HIAPs were dichotomized (academic impact or not) and then ranked by proportion. The top 10 HIAPs were compared across academic year using the Marascuilo multiple-proportions comparison technique and Odds Ratios. Results: The top HIAPs included mental, social, and physical health factors. The prevalence of each HIAP increased in proportion between the 1st and 4th year. Conclusion: This study provided estimates of health impact on academic performance by academic year. The increase in HIAPs was reported by academic warrants universities to address the influence of health on academic performance specific to mental and social health early in a student's college career.

Keywords: Marascuilo, college student health, NCHA, academic performance

Introduction

Health and well-being are critical components to effective learning and cognitive function within the college student population (Ansari & Stock, 2010). Kuh, Kinzie, Buckley, Bridges, and Hayek (2006) proposed a model of college student academic success with college outcomes being explained by the sum of precollege and the college experiences. The college experience in this model is comprised of student behaviors and institutional characteristics. However, health-related factors are often not considered or are overlooked by educational institutions when monitoring and evaluating student success (Economos, 2008), thus suggesting a gap in explaining academic outcomes. Moreover, universities often do not have adequate resources to meet the health needs of all students. Therefore, targeting of health education and promotion programming is warranted to result in the greatest impact on academic performance.

The impact of health on academic performance is a clustered interaction and interplays between multiple factors where targeting one health behavior in a silo may be insufficient to result in significant changes to either that behavior or academic performance (Grizzell & McNeil, 2007; Upright, Esslinger, & Hays, 2014). DeBeard, Spielmans, and Julka (2004) developed an integrative model that included health behaviors in tandem with

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measures of academic preparedness. This model was able to explain more than half of the variance in first semester GPA. Universities often place the majority of the health promotion emphasis within the first and second year, negating students at advanced years (Allen & Robbins, 2007). Currently, there is a dearth in the literature that explains the impact of health on academic performance across academic year given that the majority of the literature about academic performance and health focused on freshman students.

Describing the prevalence of student health impediments in relation to academic performance as a whole and across academic year shows promise in improving targeted college health programming and solidifying the relationship of health to academic outcomes. Negating differences in health impediments to academic performance (HIAP) could reduce the equity of health programming and academic success across the entire college experience. This inquiry aims to improve understanding of the relationship between undergraduate student health and academic performance by assessing the prevalence of self-reported perceived impact of health on academic performance by academic year.

The purpose of the current investigation was to explore the prevalence of health impediments to academic performance (HIAP) and their statistical differences across academic year for undergraduate, full-time, domestic college students using National College Health Assessment II (NCHA-II) data. This inquiry had 2 research aims. The first aim was to rank the 30 HIAPs included in NCHA-II data by highest overall prevalence. The second aim was to employ a population proportion multiple comparison technique on the top 10 ranked HIAPs to assess statistically significant differences in proportions across academic year with a report of Odds Ratios for the HIAPs with the largest difference in proportion by academic year.

Methodology

The study sample was derived from the National College Health Assessment II (NCHA-II) data made available by the American College Health Association (ACHA) which included Fall cohorts from 2008-2013 (ACHA, 2016). Data were merged and managed in a columns-wise format using a sequence identifier variables across all cohorts performed using SPSS version 22 (IBM, Chicago, IL, 2013). The total number of subjects prior to applying inclusion criteria was n = 179,961. Inclusion criteria were applied as follows: (a) Undergraduate, degree-seeking students (exclude graduate, non-degree, other, and missing), (b) Full-time enrollment (exclude part-time, other, and missing), (c) Domestic students (excluded international students), (d) Domestic institutions (excluded institutions outside of the United States), and (e) Exclude GPA that was either not reported or system missing. The final sample size following inclusion and exclusion criteria was n = 120,434.

For this analysis, 30 Health Impediments to Academic Performance (HIAP) were included derived from question 45A-D of the NCHA-II instrument. Note that the survey instrument is not available for public use. However, question structure can be seen via the section C in the 2013 NCHA Executive Summary (ACHA, 2017). The HIAPs were originally measured using a 1 through 6 Likert scale as follows: 1-Not Applicable, 2-Experienced but no Academic Impact, 3-Received Lower Grade on Projects/Assignments, 4-Lower Grade in Class, 5-Unable to Complete, Failed, or Dropped Class, and 6-Significant Disruption to Academic Program, see Table 2. For analysis, the HIAP measures were dichotomized based on either the lack of an effect on student academics (1-Not Applicable, 2-Experienced but no Academic Impact) or the presence of effect on student academics (3-Received Lower Grade on Projects/Assignments, 4-Lower Grade in Class, 5-Unable to Complete or Dropped Class, and 6-Significant Disruption to Academic Program). Only the top 10 HIAPs proportions

were compared across academic year.

Statistical Analysis

The proportion of the total student sample reporting academic impediment for each HIAP was ranked from largest to lowest proportion influenced, see Table 1. The top 10 HIAP ranked by proportion to assess the proportion of students reporting academic impact for each health factor by academic year, see Figure 1. Separate Chi-Square Tests of Independence (χ^2) were used to identify dependence between the proportion reporting academic influences compared to the proportion not reporting academic influence for each of the top 10 HIAPs.

For HIAPs with statistically significant χ^2-tests, a proportion multiple comparison technique was employed to assess statistical difference for each HIAP across academic year. To compare the proportions for a HIAP by academic year and to determine the presence of statistically significant differences between any possible pairwise proportion comparisons, the Marascuilo (1966) multiple proportion comparisons test was employed. Marascuilo (1966) proposed a χ^2 *post hoc* multiple comparisons procedure for proportions. This procedure provides a control for the probability of making a Type I error, for all possible pairwise proportion comparisons. The initial step takes samples of size n_i (i = 1, 2, …, k) from each of the k populations and computes the differences (p_i - p_j, where $i \neq j$) between all $k(k-1)/2$ pairs of proportions where i and j are two academic years within the HIAP. The absolute values of these pairwise differences are the test statistics. The critical values from the χ^2 distribution and given significance level are derived using the following:

$$r_{ij} = \sqrt{\chi^2_{(\alpha,k-1)}}\sqrt{\frac{p_i(1-p_i)}{n_i} + \frac{p_j(1-p_j)}{n_j}}$$

The final step is to compare each of the $k(k-1)/2$ test statistics to the r_{ij} value. Test statistics for proportion pairs that exceed the critical value are statistically significant at the significance level (α). In the present study, the number of comparisons for each health factor was k = 5, representing each academic year. The results of the multiple comparisons procedure were described using an independent letter to identify which population proportions are different. Pairwise proportions with a different letter indicate a statistical difference, whereas the same letter indicates no statistical difference. Situations, when combinations of letters are present, would indicate this particular academic year was not statistically different from multiple academic years. For example for 4th year students, a code of "ab" would indicate that the 4th year was not statistically different from the 1st and 2nd year. Note however, that the transitive property is not necessarily implied (i.e. if 4th was not statistically different from 1st and 2nd, we cannot imply that the 1st is not statistically different from the 2nd). The threshold of significance was set at $p \leq 0.01$ to minimize the possibility of type 1 error to be conservative in identifying statistical significance given the large sample size. Odds Ratios (OR) were calculated and reported for HIAPs with the largest difference in the odds of the cohort by academic year experiencing academic impact. This was meant to indicate the magnitude of change in likelihood of an HIAP influencing academic performance between academic years.

Results

The top 10 HIAPs were Stress, Alcohol, Anxiety, Sleep Difficulties, Cold/Flu/Sore Throat, Work Outside of School, Extracurricular Commitments, Internet Use, Concern for a Friend/Family, and Relationship

Difficulties in order from highest prevalence of academic impact to lowest. See Table 1 for ranked order of HIAP and Figure 1 for the top 10 HIAPS.

Marascuilo Multiple Proportion Comparisons

All χ^2 tests of independence for health impediment by academic year reached statistical significance, $p < 0.001$. Therefore, multiple comparisons testing for proportion difference was performed on the top 10 HIAPs, see Table 2 for results of the multiple comparison procedure. One HIAP, Anxiety, was chosen to assist in the interpretation of Table 2. For this HIAP, there was not a statistically significant difference in the proportion of students reporting anxiety as an impact to their academics between the 3rd and 4th years as well as the 4th and 5th years. There were statistically significant differences for the remainder of all other academic year pair-wise comparisons within Anxiety. For all HIAPs, there was an increase in proportion of academic impact across academic year up to the 4th year with the exception of extracurricular activities which remained static across academic year and internet use which decreased as academic year increased. More specifically, stress and alcohol use had significant increases in proportion reporting academic impact up to the 4th year. For anxiety, there a significant increase in proportion reporting academic impact up to the 3rd year while sleep, acute illness, and concern for family member only had significant increases up the 2nd year. Work however had statistically significant increases in prevalence across all academic years. Specific to the 5th year there was a statistically significant decrease from the 4th year for alcohol and extracurricular activities and non-significant decreases for acute illness, and stress. See Figure 2 for illustration of proportion reporting impediment by HIAP and academic year.

Odds Ratios

For Alcohol, the largest difference in HIAP for adjacent years was from the 1st to 2nd years. The odds of students reporting alcohol consumption as an academic impact was 1.27 times more likely in their second year compared to their first. Students were 1.68 and 1.64 times more likely to report an academic impact in the 4th year compared to their 1st year for Stress and Anxiety, respectively. The HIAP with the greatest increase in likelihood academic impedance was for Work where students were 3.10 and 3.44 times more likely to report an academic impact due to work in their 4th and 5th year, respectively, compared to their 1st year.

Comment

The purpose of the study was to explore the prevalence of self-reported student health impediments to academic performance (HIAP) and their statistical differences across academic year for undergraduate, full-time students by employing a multiple comparisons technique for proportions. This investigation had multiple novelties that built off the findings of Upright, Esslinger, and Hays (2014) who reported the top 10 HIAP using NCHA data specific to 1 university. The present investigation utilized 5 years of national NCHA-II data with a large sample size thus having robustness of the proportion estimates. Additionally, past studies have reported frequencies and executive summaries of NCHA data rather the current investigation utilized a novel approach incorporating the Marascuilo multiple comparisons technique for proportions that allowed for statistical comparisons of proportions for HIAPs across academic year.

A major finding of this investigation suggests that the impact of health on academics starts during the 1st year and becomes more profound. This finding suggests that there might be a challenge in a student's ability to cope with the challenges of college life as student proceeds through college. Balduf (2009) and Seidman (2005)

support the notion that if students do not present with the skills and behaviors needed to cope with this life change and transition from high school to the beginning of and through the undergraduate experience, their academic outcomes are likely to be hindered. Specifically given that 4th and 5th year students are more likely to report work, relationships, and extracurricular activities as an impediment to academic performance compared to 1st year students, the ability to balance their academic activities with aspects of life outside of school might impair their ability to succeed academically (Gröpel & Kuhl, 2009). Note however, that this investigation was cross-sectional thus direct conclusions cannot be made across academic year as each year was a mutually exclusive sample. Future investigation is warranted exploring the health related coping and skill capacities of colleges to deal with the rigors of college life.

Another major finding of this investigation is that mental health related impediments are strong influencers of academic impact. The results of the current investigation highlighted a strong influence of mental health with regard to perceived academic impediment within the undergraduate student population given that 6 of the 10 (with 4 being the top) HIAPs were related directly to mental health. More specifically, 4th year students were almost 70% more likely to report stress and anxiety as an influencer of their academic performance. This finding corroborates with Keyes, Eisenberg, Perry, Dube, Kroenke and Dhingra (2012) who asserted that mental health factors influence academic outcomes. The impact of mental health and more specifically the locust of control students either present with or develop in college to control their academic performance and their health (Twenge, Zhang, & Im, 2004) can be shaped by the skills and knowledge capacities developed prior to and during this point in their lives. The development of such skills and capacities has shown promise in the K-12 age population whose impact is likely to continue into adulthood (Bradley & Greene, 2013). Given this impact in the adolescence, further investigation is warranted in health promotion programming at the collegiate-level.

In addition to the mental health dimension of health, the current analysis also identified social health as a strong determinant of academic impediment. Junco (2012) as well as Kirschner and Karpinski (2010) highlights that increased social connectivity, its impact on academic engagement, and the amount of time and effort a student devotes to their academic experience, can drastically impact academic outcomes. It is suggested that social support and connectivity are likely determinants of academic success.

However, Read, Wood, Kahler, Maddock, and Palfai (2003) found a relationship between depression and social connectivity moderated by alcohol consumption for 1st and 2nd year college students. Related to academic performance of college students, Singleton and Wolfson (2009) found a negative relationship between alcohol consumption and academic performance. This relationship spanned all levels of pre-college academic preparation thus positing that the influence of alcohol is likely independent from the precollege academic performance. Second year college students in the present study were 27% more likely to report alcohol as impediment to their academic performance than 1st year students. The sum of the investigations finding with support from the literature suggests that alcohol consumption in the first year might be the impetus that leads to lack of retention and impaired academic performance in college.

Recommendations & Implications

The results of this investigation highlight possible areas of focus for universities to develop, implement, and evaluate health related programming to improve academic outcomes. Recommendations from both Sawatzky, Ratner, Richardson, Washburn, Sudmant, and Mirwaldt (2012) and Upright, Esslinger, and Hays (2014) reinforce the need for university policy to implement programming to identify and moderate the effect

of student health problems and its impact on academic performance. The ACHA Healthy Campus 2020 agenda identified recommendations regarding student health and academic success through exploring the influence of health on academics specifically called for health administrators and services on college campuses to recognize the impact of student health to optimize academic performance and wellness of the student population (Grizzell & McNeil, 2007; Upright et al., 2014; ACHA, 2016). This study offers perspective and guidance on when students can be targeted for intervention or promotion programming.

The authors support and suggest that health interventions and programs should be targeted to college students early in their college careers given the trend for HIAPs to increase in prevalence by academic year. Furthermore, interventions should focus on mental and social health facets of student health given the high prevalence reported in this investigation. Such programming should focus on the behavioral capacities (knowledge, skills, and attitudes) needed to cope with the transition to college life. Balduf (2009) and Seidman (2005) discuss the impact of students not presenting with the skills and behaviors needed to cope with this life change and transition from high school to the beginning of and through the undergraduate experience. Specifically the student's ability to balance their academic activities with extracurricular activities might impair their ability to succeed.

Limitations

This study utilized secondary, observational data based on a created HIAP measure dichotomized from the NCHA instrument as well as GPA measures that were cross-sectional and self-reported. A major limitation was that the HIAP values do not account for the severity of the academic impedance from the health factor beyond a binary indication of impact or no impact. Furthermore, no measure of validity or reliability was employed to assess measurement adequacy or consistency of impact on academic outcomes beyond self-reported impact. Future studies should assess validity and reliability of both the health impediment as well as academic performance to elucidate the relationship between the former and latter.

The NCHA instrument has been reported by the American College Health Association as not being representative given that participation is dependent in institutional willingness (ACHA, 2016). Therefore the proportion estimates, although robust given the large sample size in this study, are not intended to be generalizable to the undergraduate student population in the United States. Future investigation is warranted using the population proportion estimates findings by HIAPs to better inform and target university and college health programming.

Table 1

Ranked Order of Self-reported Health Indicators of Academic Performance

		Effect reported		No effect		No reponses	
Rank	Health impediment	Percentage	Count	Percentage	Count	Percentage	Count
1	Stress	72.1%	86,807	26.8%	32,276	1.1%	1,351
2	Alcohol	56.8%	68,423	42.4%	51,083	0.8%	928
3	Anxiety	55.8%	67,222	43.1%	51,902	1.1%	1,310
4	Sleep difficulties	51.4%	61,893	47.6%	57,369	1.0%	1,172
5	Cold/flu/sore throat	50.0%	60,171	49.1%	59,116	1.0%	1,147
6	Work outside of school	43.7%	52,575	54.8%	66,024	1.5%	1,835
7	Extracurricular commitments	43.0%	51,760	55.8%	67,165	1.3%	1,509

(Table 1 continued)

		Effect reported		No effect		No reponses	
Rank	Health impediment	Percentage	Count	Percentage	Count	Percentage	Count
8	Internet use	39.4%	47,394	59.5%	71,645	1.2%	1,395
9	Concern for family/friend	36.8%	44,358	62.1%	74,811	1.1%	1,265
10	Relationship difficulty	32.9%	39,679	65.9%	79,317	1.2%	1,438
11	Allergies	30.2%	36,415	68.9%	82,971	0.9%	1,048
12	Finances	30.1%	36,301	68.6%	82,663	1.2%	1,470
13	Roommate issues	27.7%	33,313	71.4%	85,955	1.0%	1,166
14	Homesickness	26.5%	31,923	72.4%	87,147	1.1%	1,364
15	Depression	23.7%	28,592	74.9%	90,254	1.3%	1,588
16	Infection	19.8%	23,802	79.1%	95,254	1.1%	1,378
17	Death of family/friend	17.3%	20,816	81.6%	98,272	1.1%	1,346
18	Injury	12.3%	14,812	86.4%	104,091	1.3%	1,531
19	Chronic illness	9.6%	11,611	89.4%	107,638	1.0%	1,185
20	Chronic pain	9.5%	11,477	89.4%	107,713	1.0%	1,244
21	ADHD	8.8%	10,633	90.0%	108,364	1.2%	1,437
22	Drugs	8.6%	10,356	90.2%	108,686	1.2%	1,392
23	Learning disabilities	5.8%	6,999	92.5%	111,364	1.7%	2,071
24	Discrimination	5.1%	6,181	93.7%	112,838	1.2%	1,415
25	Eating disorders	4.9%	5,929	94.0%	113,160	1.1%	1,345
26	Sex assault	3.4%	4,042	95.4%	114,882	1.3%	1,510
27	Physical assault	3.1%	3,778	95.7%	115,202	1.2%	1,454
28	Gambling	3.0%	3,583	96.0%	115,600	1.0%	1,251
29	Pregnancy	2.1%	2,562	96.8%	116,573	1.1%	1,299
30	STI	2.1%	2,487	96.7%	116,493	1.2%	1,454

Note. Values represented as percentages (%) and counts ranked by decreasing order of SHIAP effect on GPA based on the NCHA total sample.

Table 2

Multiple Comparisons of Top 10 Self-reported Health Indicators of Academic Hardship by Academic Year

Rank	Health Impediment	1st year	%	2nd year	%	3rd year	%	4th year	%	5th year	%	χ^2 (df = 4)
1	Stress	24,681	66% a	19,690	73% b	20,700	75% c	16,632	77% d	5,104	76% cd	1,116.19*
2	Alcohol	13,679	36% a	11,357	42% b	12,177	44% c	10,866	50% d	3,004	45% c	1,092.76*
3	Anxiety	13,539	36% a	11,643	43% b	12,899	47% c	10,466	48% cd	3,355	50% d	1,245.71*
4	Sleep	18,048	48% a	14,032	52% b	14,626	53% b	11,482	53% b	3,705	55% c	250.21*
5	Acute illness	18,013	48% a	13,334	50% b	14,078	51% bc	11,381	52% c	3,365	50% abc	113.93*
6	Work	10,721	29% a	11,714	44% b	14,232	51% c	12,035	55% d	3,873	58% e	5,895.29*
7	Extracurricular Activity	16,170	43% a	11,745	44% a	11,994	43% a	9,620	44% a	2,231	33% b	272.69*
8	Internet use	15,198	41% a	10,958	41% a	10,726	39% b	8,122	37% bc	2,390	36% c	122.74*
9	Concern for family or friend	12,203	33% a	10,063	37% b	10,670	39% bd	8,705	40% cd	2,717	41% d	472.24*
10	Relationships	11,046	29% a	8,851	33% b	9,596	35% c	7,694	35% cd	2492	37% d	357.86*
	Total sample	37,479		26,850		27,685		21,740		6,680		

Notes. Results displayed as the specific proportion of students perceived academic impediment by health stratified by academic year. Same letter by health impediment indicate no significant differences ($p > 0.01$) between academic years according to the Marascuillo's multiple comparison of proportions; * Indicate significance of χ^2 Test of Independence for health impediment by academic year, $p < 0.001$.

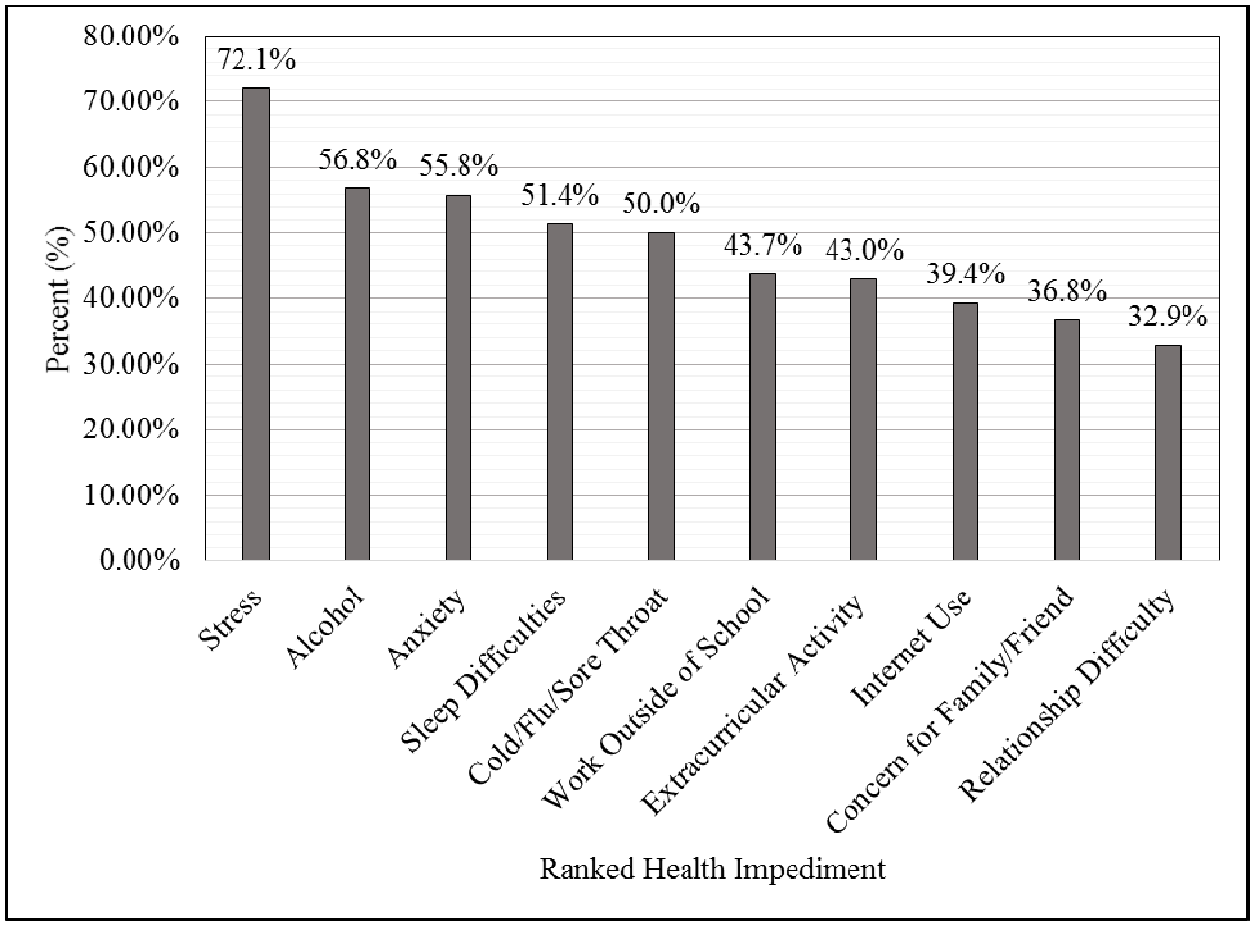

Figure 1. Top 10 health impediments of academic performance.

Note. Values represented as percentages (%) for the total sample ranked by decreasing order of HIAP effect on GPA based on the NCHA total sample.

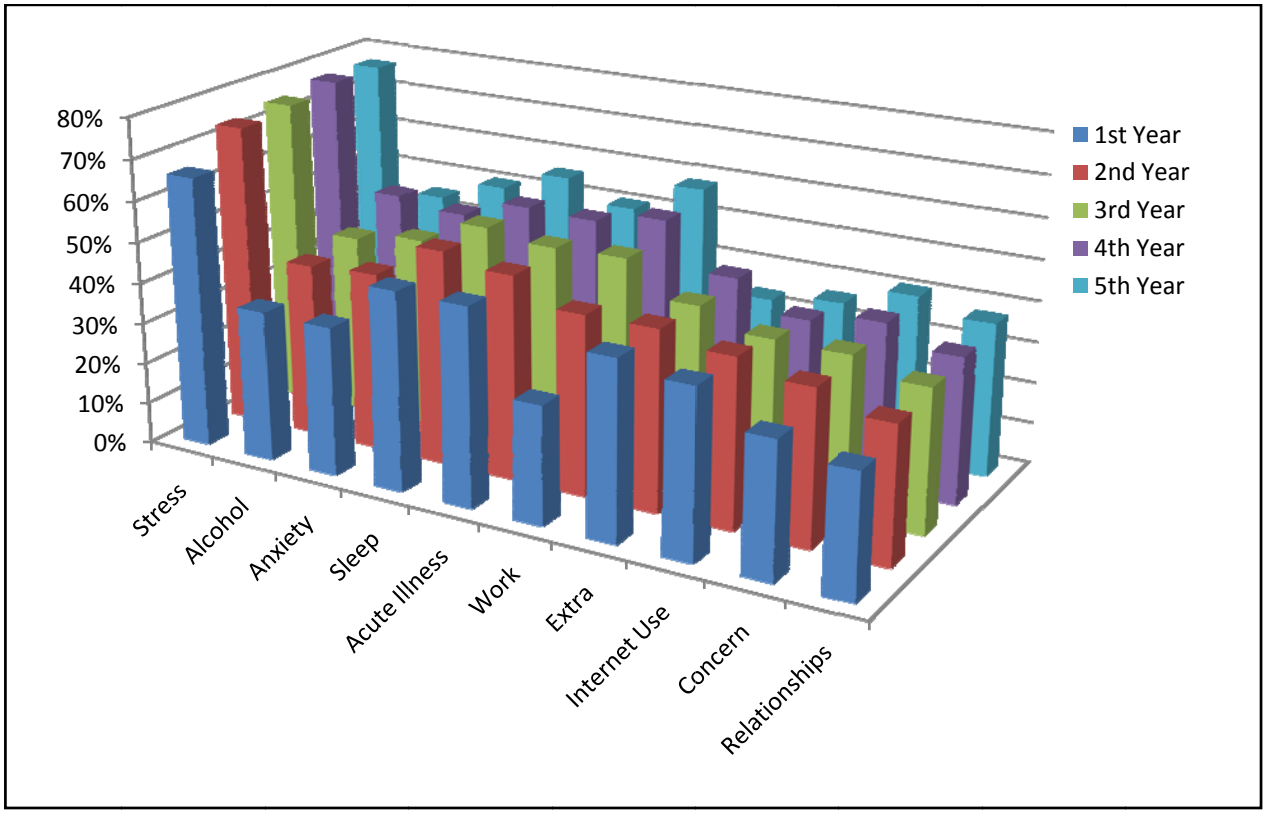

Figure 2. Marascuilo multiple comparisons of 10 health impediments of academic performance across academic year.

Notes. Value represented as proportions (%) of the total sample by academic year. Extra = Participation in Extracurricular Activities and Concern = Concern for Family/Friend.

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