



Can leading a physically active and healthy lifestyle prevent gaining the freshman 15?

original paper

DOI: <https://doi.org/10.5114/hm.2023.127976>

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ABSTRACT

Purpose. The purpose of this study is to investigate if leading a physically active and healthy lifestyle can prevent the weight gain typically experienced during the freshman year of college – the ‘Freshman 15’.

Methods. Study participants ($N = 525$) were from three cohorts of incoming students (2018–2020) at a mid-sized university in the West South-Central United States. The weight of each study participant was measured at three points over a year: beginning of their first semester, beginning of their second semester, and beginning of their third semester. During the study, students were encouraged to lead physically active and healthy lifestyles and to exercise daily. Weight changes at sixth months and one-year intervals were recorded as percentages.

Results. Freshmen weight gain/loss depended upon initial weight with freshmen who arrived on campus with relatively lower weights (≤ 100 kg) tending to gain weight, especially males, whilst freshmen who arrived on campus with relatively higher weights (≥ 100 kg) tended to lose weight. This finding was both more apparent and more statistically significant at the 1-year mark than at the 6-months mark.

Conclusions. Several previous studies have linked freshmen weight gain to initial weight with students with higher initial weights gaining the most. However, our results show that maintaining a physically active and healthy lifestyle when entering college reverses this trend – with students with high initial weights losing weight. Thus, living a physically active and healthy lifestyle, which includes aerobic exercise, can prevent the fat mass weight gain often experienced by college freshmen.

Key words: body weight changes, exercise, universities, students, healthy behaviour

Introduction

A student’s transition into college is often accompanied by an increase in problematic health and lifestyle behaviours, such as lack of sleep [1, 2], maladaptive ways of coping with stress [3, 4], increased alcohol consumption [5–8], unhealthy eating [3, 5, 8–14], and lack of physical activity [13–16]. These changes in lifestyle often result in students gaining weight during their freshman year – colloquially known in the United States as the ‘Freshman 15’. While significant weight gain during a student’s freshman year in college has been a common finding in research, a meta-analysis of studies show a mean weight gain closer to 3–4 lbs

(1.3–1.7 kg) [17, 18] over the first year, significantly less than the ‘Freshman 15’ (6.8 kg). According to various studies, the majority of students who gain weight during freshman year gain on average 7–8 lbs (3.5 kg) [16, 18]. For individuals that carry this extra weight past college, this may contribute to both physical complications, such as body pain and difficulty with physical functioning, and additional struggles with body image, both of which can affect mental health [16]. These changes in weight gain from the transition into the freshman year of college may have an effect on obesity into adulthood and other significant negative health outcomes. So, it continues to be important to investigate the relationship between lifestyle and col-

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Received: December 20, 2022

Accepted for publication: June 4, 2023

Citation: Anderson JR, Bloom MJ, Broshous WT, Chen GYX, Jost SR, Lang ASID, Neto Luiz CLDS, Mankin NV, McMahan ER, Merheb JA, Nelson PP, Valderrama-Araya EF. Can leading a physically active and healthy lifestyle prevent gaining the freshman 15? Hum Mov. 2023;24(4):118–125; doi: <https://doi.org/10.5114/hm.2023.127976>.

lege student weight gain in order to help in the prevention of obesity and other negative health risks and hopefully to be able to change these current trends [17, 18].

Recently, Beaudry et al. [5] found that the body mass index (BMI) of first year university students increased for both males and females and that weight gain in males was more than females (8.38 pounds [3.8 kg] and 3.97 pounds [1.8 kg], respectively). They found that while the intake of calories remained relatively constant over the course of the year, the quality of diets worsened. Furthermore, the amount of alcohol consumed was greater in males than in females, which could be a contributing factor in the overall weight gain during freshman year. The results of Bodenlos et al. [6] similarly found that males gained more weight than females (6.39 pounds [2.9 kg] and 4.38 pounds [2.0 kg], respectively) over the course of a year and again found that alcohol use was associated with weight gain among males.

Several studies have found that weight gain depends upon baseline weight, with heavier students gaining the most weight [4, 16, 19]. For example, Miller and Hartman [16] found that the greatest weight gain occurred for participants who had baseline BMIs > 25 ($p < 0.05$). Analysing Open Data from two other studies [5, 19], the authors of this paper also found that weight gain depended upon baseline weight, with heavier students gaining the most weight (see the results section below). Notably, contrary to other research, Mihalopoulos et al. [21] reported that students with higher baseline BMI values lost weight, though the study used self-reported data, where heavier people tend to underestimate their weight [22]. Additionally, the response rate was poor and used a small sample, limiting the strength of this study.

Unlike the majority of university students in the United States, the students in this study were required to sign an Honor Code Pledge [23]. This pledge asked students to commit to a variety of behaviours and beliefs, including refraining from any kind of alcoholic consumption and tobacco use for the duration of their time at the University. The Honor Code reflects the University's whole person-education philosophy. Additionally, health fitness courses are required each semester. It is conjectured that whole-person education encourages health-promoting behaviours which could impact the overall weight gain for freshmen adopting this philosophy. Even though our students experience weight issues related to sleep issues just like any other typical college student [24, 25], we hypothesise that, in general, lower average weight gains will be expected for our

students when compared with other institutions of higher education in the United States. Thus, the aim of this study is to investigate if leading a physically active and healthy lifestyle can prevent the weight gain typically experienced during the freshman year of college – the 'Freshman 15'.

Material and methods

Participants

Data were collected in three cohorts (August 2018 – August 2019; August 2019 – August 2020; and August 2020 – August 2021) with the weight of 1,107 out of a total of 1,369 freshmen measured and recorded as part of the institution's required aerobics program. Of the initial 1,107 students with recorded first semester freshmen weight measurements, 525 had their weight measured either six months later (369 students: 123 male; 246 female) or a year later (242 students: 50 male; 192 female) with an intersection of 86 students (16 male; 70 female) who had their weight measured at both the six months and one year intervals. The data were collected for the three cohorts as follows, total $N = 525$ students: 2018–2019, 190 students; 2019–2020, 229 students; and 2020–2021, 106 students. The data used in this study is available as open data (CC0) from figshare [26].

Participants' physically active and healthy lifestyle requirements

All students at the institution sign an Honor Code by which they agree to lead a physically active and healthy lifestyle that includes pledges such as: 'to develop my body with sound health habits by completing the required aerobics program and by participating in wholesome physical activities' and 'I will not take any illegal drugs or misuse any drugs... I will not drink alcoholic beverages of any kind; I will not use tobacco' [23]. All students at the institution are also required to take a health and physical exercise class every semester in which they are enrolled full time with levels of physical activity collected automatically using wearables for most students [27].

SARS-CoV-2 Virus

The COVID-19 pandemic affected the second two cohorts with the institution switching to fully virtual instruction from March 23, 2020, until May 1, 2020. Outside of these dates, the institution was fully open

and in session with hybrid instruction, with all study participants attending classes either in person or via Zoom (Fall 2020 only – 3 study participants were fully virtual). During the pandemic, even though students were still required to participate in the institution's required aerobics program, a decrease in levels of physical activity was noted – though not to the same extent as at other institutions [28].

Statistical analysis

Normality tests were conducted using a Shapiro-Wilk test for one variable. The change in body weight at various time intervals was analysed using Wilcoxon rank-sum tests for cases with two measurements and Friedman's test for cases with three measurements. Data processing, generation of summary statistics (median and interquartile range [IQR]) and linear regressions analyses, using the *lm* function, were performed using R 4.2.0 [29]. Changes in body weight were calculated on a participant-by-participant basis and are reported both in absolute and percent measure in the Open Data dataset [26].

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the authors' institutional review board (approval No.: IRB#: F2018-14).

Informed consent

All incoming students at the institution are informed about and given the choice to opt into the institution's aerobics points tracking system which collects various health and wellness-related data both automatically via wearable devices and through labs and surveys that may be used, when anonymised, in institutional IRB-approved research studies. Students who did not opt into the program (the default) are not included in this study.

Results

Of the 525 participants, 30% were male ($N = 157$) and 70% were female ($N = 368$). Ninety-nine percent of students lived on campus in dormitories ($N = 522$) the entire time with 1% ($N = 3$) choosing to live at home during the Fall of 2020 due to the COVID-19 pandemic. Since the body weights of both males (initial weight, $W = 0.95$, $p < 0.001$; 6-month weight, $W = 0.96$,

$p < 0.001$; 12-month weight: $W = 0.90$, $p < 0.001$) and females (initial weight, $W = 0.88$, $p < 0.001$; 6-month weight, $W = 0.90$, $p < 0.001$; 12-month weight: $W = 0.89$, $p < 0.001$) were not normally distributed, median and interquartile ranges (IQR) are reported instead of means and standard deviations.

Overall, 58.5% (56.5% of females; 62.6% of males) of participants gained some weight over the first six months, with a median increase of 0.9 kg (2 lbs) and 1.4 kg (3.1 lbs) over 6 and 12 months, respectively. For those participants that gained weight, the median weight gains were 2.5 kg (5.5 lbs) and 3.2 kg (7.1 lbs) at 6 and 12 months, respectively.

We analysed the change in body weight at both time intervals (6 months and 12 months) using the Friedman test for both males and females. First, the Friedman test was applied to the female subset of the data. The test results showed that the Friedman chi-squared value was 4.239, with a p -value of 0.1201. These results suggest that there was no significant difference at the $p = 0.05$ level in body weight between the three measurements for females.

Next, the pairwise Wilcoxon rank sum test with continuity correction was applied to the female subset of the data. The test results showed that there was no significant difference in body weight between measurements 0 and 6, or between measurements 0 and 12 (p -value = 0.12 and 0.13, respectively). The p -value adjustment method used was the Bonferroni method.

Similarly, the Friedman test was applied to the male subset of the data. The test results showed that the Friedman chi-squared value was 3.6333, with a p -value of 0.1626. These results suggest that there was no significant difference at the $p = 0.05$ level in body weight between the three measurements for males.

The pairwise Wilcoxon rank sum test with continuity correction was applied to the male subset of the data. The test results showed that there was no significant difference in body weight between measurements 0 and 6, or between measurements 0 and 12 (p -value = 1). The p -value adjustment method used was the Bonferroni method.

Six months weight gain

The body weight changes for the study participants after 6 months are summarised in Table 1. Males, on average, gained more weight (median gain = 1.4 kg) than females (median gain = 0.9 kg), though not at a statistically significant level (Friedman: chi-squared = 4.239, p -value = 0.1201).

Table 1. Median body weight values and weight change from 1st semester freshman year to 2nd semester freshman year in male ($N = 123$) and female ($N = 246$) students. Median \pm IQR

Body weight (kg)	Initial	6 months	Change
Males	76.2 \pm 19.3	76.7 \pm 18.2	1.4 \pm 4.5
Females	61.7 \pm 16.1	62.8 \pm 17.2	0.9 \pm 3.6

Regression analysis shows that weight gain/loss depends upon initial weight. That is, freshmen who arrive on campus with comparatively lower body weights (less than about 100 kg) tend to gain weight (especially males) while students who arrive on campus with comparatively higher body weights (greater than about 100 kg) tend to lose weight. See Figure 1 and Equations 1 ($\text{Adj-R}^2 = 0.01$, $p = 0.03$), 2 ($\text{Adj-R}^2 = 0.02$, $p = 0.01$; Sex: male = 1, female = 0, $p = 0.06$), 3 ($\text{Adj-R}^2 = 0.02$, $p = 0.002$), and 4 ($\text{Adj-R}^2 = 0.03$, $p = 0.003$; Sex: male = 1, female = 0, $p = 0.1$).

Six month weight gain relationships

- (1) weight gain = $2.67 - 0.026 * \text{initial_weight}$
- (2) weight gain = $2.95 - 0.034 * \text{initial_weight} + 0.82 * \text{sex}$
- (3) percent weight gain = $4.92 - 0.050 * \text{initial_weight}$
- (4) percent weight gain = $5.24 - 0.059 * \text{initial_weight} + 0.95 * \text{sex}$

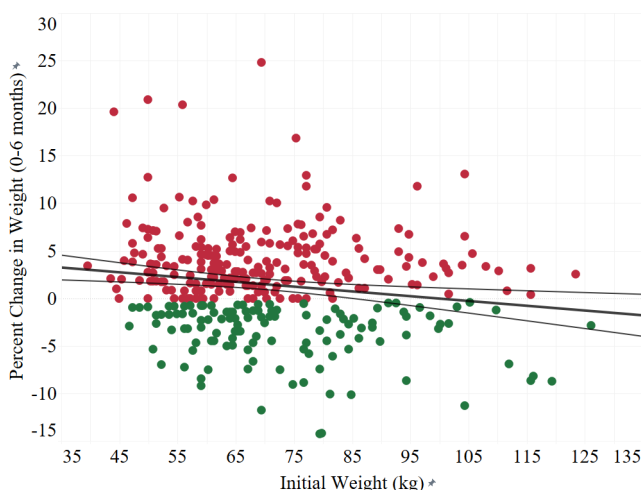


Figure 1. Percent change in body weight by initial body weight (0–6 months) showing a downward trend crossing the x-axis at around 100 kg

One year weight gain

The body weight changes for the study participants after 12 months are summarised in Table 2. Males, on average, gained more weight (median gain = 1.8 kg) than females (median gain = 0.9 kg), though again

not at a significant level (Friedman: chi-squared = 3.6333, p -value = 0.1626).

Table 2. Median body weight values and weight change from 1st semester freshman year to 1st semester sophomore year in male ($N = 50$) and female ($N = 192$) students. Median \pm IQR

Body weight (kg)	Initial	12 months	Change
Male	72.6 \pm 14.8	74.8 \pm 17.6	1.8 \pm 4.0
Female	63.8 \pm 20.4	64.9 \pm 19.7	0.9 \pm 4.1

Regression analysis shows that weight gain/loss after one year still depends upon the initial weight. That is, freshmen who arrive on campus with comparatively lower body weights (less than about 100 kg) tend to gain weight (especially males) while students who arrive on campus with comparatively higher body weights (greater than about 100 kg) tend to lose weight. At the 12-month mark, this effect is even more apparent and statistically more significant than at the 6-month mark. See Figure 2 and Equations 5 ($\text{Adj-R}^2 = 0.06$, $p < 0.001$), 6 ($\text{Adj-R}^2 = 0.08$, $p < 0.001$; Sex: male = 1, female = 0, $p = 0.02$), 7 ($\text{Adj-R}^2 = 0.08$, $p < 0.001$), and 8 ($\text{Adj-R}^2 = 0.09$, $p < 0.001$; Sex: male = 1, female = 0, $p = 0.06$).

One Year Weight Gain Relationships

- (5) weight gain = $5.13 - 0.057 * \text{initial_weight}$
- (6) weight gain = $5.17 - 0.063 * \text{initial_weight} + 1.59 * \text{sex}$
- (7) percent weight gain = $8.05 - 0.086 * \text{initial_weight}$
- (8) percent weight gain = $8.10 - 0.092 * \text{initial_weight} + 1.68 * \text{sex}$

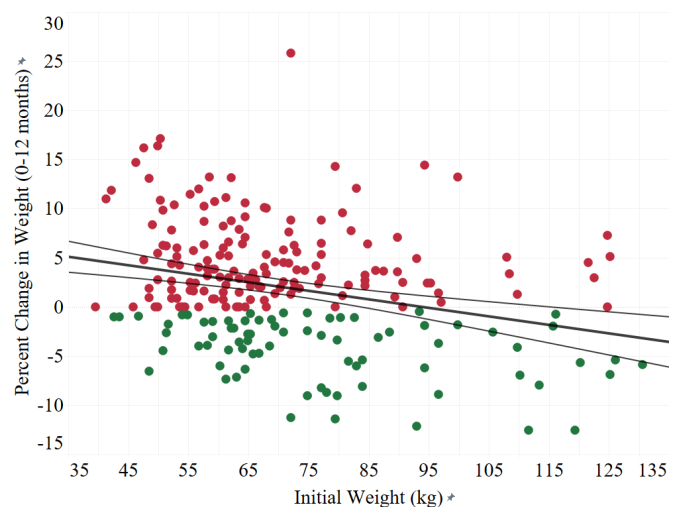


Figure 2. Percent change in body weight by initial body weight (0–12 months) showing a downward trend crossing the x-axis at around 100 kg

Open data analysis

Many research groups, including us, follow FAIR principles [30] and make their data available to other researchers either by request or ideally via an Open Data repository, such as figshare. This allows other researchers to analyse their data, not only to check their results, but to also repurpose their data to find new insights not focused upon by the original authors' research. Below, we present results from analysing two datasets associated with papers by Beaudry et al. [5] and Deliens et al. [20], finding larger weight gains for students with higher baseline weights for both datasets. These results were not noted in the original studies. A full analysis is provided for the Beaudry et al. [5] data, as it is not publicly available, and summary results are presented for the data from the Deliens et al. [20] study.

Beaudry et al. For comparison's sake to our results, an Open Data request for the data in the paper by Beaudry et al. [5] was made and generously granted. The dataset provided by Beaudry et al. [5] consists of 301 first-year students ($N = 229$ females), aged 17–20 years, in attendance at Brock University (St. Catharines, Ontario, Canada) in two cohorts (2014–2015 and 2015–2016). The participants in Beaudry et al.'s [5] study, on average, gained body weight and fat during their first academic year (6–8 months) of university studies ($p < 0.001$).

The body weight changes for the study participants are summarised in Table 3. Males, on average, gained more weight (median gain = 3.1 kg) than females (median gain = 1.8 kg), and at a significant level ($W = 5248$, p -value < 0.001), including as a percent change ($W = 5899.5$, p -value < 0.001).

Table 3. Median body weight values and weight change from 1st semester freshman year through 1st semester sophomore year (6–8 months) in male ($N = 72$) and female ($N = 229$) students at Brock University.
Median \pm IQR

Body weight (kg)	Initial	6–8 months	Change
Males	76.2 \pm 15.8	78.9 \pm 18.1	3.1 \pm 4.1
Females	59.9 \pm 12.6	61.2 \pm 13.8	1.4 \pm 3.2

Regression analysis for the data provided by Beaudry et al. [5] shows that their participants were more likely to gain weight than not gain weight, regardless of their initial weight. However, heavier participants gained the most weight. See Figure 3 and Equations 9 (Adj- $R^2 = 0.07$, $p < 0.001$), 10 (Adj- $R^2 = 0.09$, $p < 0.001$;

Sex: male = 1, female = 0, $p = 0.003$), 11 (Adj- $R^2 = 0.01$, $p = 0.046$), and 12 (Adj- $R^2 = 0.03$, $p = 0.004$; Sex: male = 1, female = 0, $p = 0.008$).

One year weight gain relationships

$$(9) \text{ weight gain} = -2.19 + 0.068 * \text{initial_weight}$$

$$(10) \text{ weight gain} = -0.99 + 0.044 * \text{initial_weight} + 1.44 * \text{sex}$$

$$(11) \text{ percent weight gain} = 0.55 + 0.043 * \text{initial_weight}$$

$$(12) \text{ percent weight gain} = 2.14 + 0.011 * \text{initial_weight} + 1.91 * \text{sex}$$

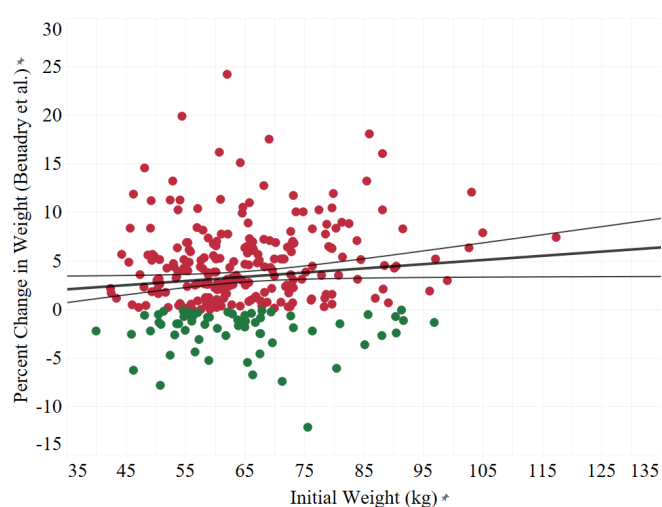


Figure 3. Percent change in body weight by initial body weight (Beaudry et al. [5] 0–9 months) showing an increasing trend and starting above the x-axis

Deliens et al. The original study by Deliens et al. [20] focused on weight, BMI, and body composition changes for $N = 340$ students at a Belgian university over a three-year period. Analysis of the publicly available dataset [31] associated with the paper for correlations between weight gain and baseline weight again showed that heavier participants gained the weight. See Equations 13 (Adj- $R^2 = 0.05$, $p < 0.001$) and 14 (Adj- $R^2 = 0.02$, $p = 0.046$).

$$(13) \text{ weight gain} = -1.72 + 0.040 * \text{initial_weight}$$

$$(14) \text{ percent weight gain} = -1.16 + 0.037 * \text{initial_weight}$$

Discussion

Studies on freshman weight gain typically find that students tended to gain weight during their freshman year, with males gaining slightly more weight than females, and with students with heavier baseline weights gaining the most weight. Yet, the current study found that our heavier students tended to lose weight during

their first 6 months. This trend of heavier students losing weight showed an even stronger effect after 12 months.

When comparing our results to those from the data collected by Beaudry et al. [5], which are typical [4, 16, 19], we find that the average weight gain of first-year university students at our institution was significantly lower. Furthermore, heavier students in Beaudry et al.'s [5] dataset tended to gain more weight than students that entered with lighter initial weights, which is again typical [4, 16, 19], whilst our heavier students actually lost weight. One possible explanation for these differences is that at our institution, students are required to engage in and maintain a physically active and healthy lifestyle as part of their general education requirements. For example, students are required to take a physical activity course each semester and monitor their activity levels through the use of a Fitbit to monitor steps and heart rate, or calculate aerobic points from the physical activity in which they engage. Our results support those of Pilcher et al. [2], namely that increasing exercise decreases the body weight of an individual.

The results of this study may also, in part, be associated with a religious and spirituality (R/S) factor at the university in which the data was collected. The institution promotes religious beliefs and has an Honor Code pledge [23] that may motivate students at the university to have a more active and healthier lifestyle when compared to students from other non-religious institutions [23]. Research indicates active participation in a healthy spiritual life may play a role in the way students choose to maintain their physical health. Previous studies have shown significant positive associations between R/S and healthy lifestyle behaviours [32–35]. R/S has been related to lower prevalence of risky behaviours, including cigarette smoking [34, 36–38] and alcohol and drug use [34, 39]. Furthermore, studies have shown positive health behaviours, including physical activity and exercise [34, 38] and healthier diet [34] are linked to strong R/S involvement.

Some limitations of our study. Firstly, weight was the only assessment used and no distinction between lean-mass gain and fat-mass gain was made. Ideally, using an additional method of assessing lean muscle mass such as the Bod Pod or skinfold testing could differentiate between lean muscle and fat in terms of weight gain.

Secondly, a measure of an improved healthy lifestyle was not measured explicitly or compared to students at other institutions and is only assumed due to the institution's environment, i.e. the institution's required aerobics program and a required honour code

pledge from all students 'to develop my body with sound health habits by completing the required aerobics program and by participating in wholesome physical activities' and 'I will not take any illegal drugs or misuse any drugs... I will not drink alcoholic beverages of any kind; I will not use tobacco'. [23] Further research could include explicit measures of assessing lifestyle and comparing them to standard measures at other institutions.

Thirdly, the last two cohorts studied were during the COVID-19 pandemic. All cohorts had mandatory exercise programs and the results were consistent for all three cohorts. Even so, an understandable decrease in levels of physical activity was noted for students during the pandemic and we note the imitation – though levels of physical activity did not decrease to the same extent as at other institutions [28].

Finally, due to the nature of the study – with participants required to sign and abide by an honour code, wear a Fitbit for the entire year, and participate in a required aerobics program – it would be hard to replicate it at another institution. We also note that the study is a post-hoc analysis and thus does not allow for a control group.

Conclusions

At our institution, the requirement of physical activity classes each semester of the university experience may help lead to lower weight gain as compared to other university programs that do not require regular physical activity of their students. This supports physical activity's role in minimising weight gain, see for example Miller and Hartman [16].

The Honor Code [23] that students at our institution sign and adhere to may be an additional factor that contributes to their healthy lifestyle behaviours that lead to the observed lower weight gain among the freshmen. This may be especially relevant when considering alcohol consumption among students at our institution (students commit to refrain from all alcohol) and other universities. A study by Burke et al. [39] found a lower alcohol use in students who had religiosity, which they deemed as a protective factor in health.

The results from our students' data reveal the efficacy of mandatory exercise programs such as those implemented by our institution. Further research could be conducted to determine what specific exercise requirements lead to the healthiest students and the type of mass gained (lean vs. fat). Students' diet could also be more carefully managed and observed to find nutrition plans that further aid in weight management.

Acknowledgements

The authors would like to thank Kayleigh M. Beaudry, Izabella A. Ludwa, Aysha M. Thomas, Wendy E. Ward, Bareket Falk, and especially Andrea R. Josse for responding to our Open Data request [5]. The authors also acknowledge the tireless work of our institution's Health, Leisure, and Sport Sciences faculty in educating students to develop a physically active and healthy lifestyle with the goal of lifelong wellness: spirit, mind, and body.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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