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1 **A longitudinal examination of students' health behaviours during their first year at**  
2 **university**

3 **Abstract**

4 **Background:** During the transition from school to higher education, young adults experience  
5 a substantial amount of change where they progress from the highly controlled setting of  
6 school to the autonomous and self-motivated environment of university. Time spent at  
7 university is considered a critical period during which young adults establish a clear sense of  
8 identity, which can include forming positive health behaviours such as regular physical  
9 activity. The transition from school to university also involves a number of changes that can  
10 impact on the mental well-being of students including financial concerns, academic pressures  
11 and a lack of social support **Aim:** To longitudinally examine the physical activity levels and  
12 mental well-being of Scottish students during their first year at university. **Methods:**  
13 Participants were 48 first year students (males, n = 24; females, n = 24) aged 18-19 years  
14 enrolled at two Scottish universities in the UK. At entry to university (semester 1)  
15 participants completed a validated self-report measure of physical activity and measures of  
16 anxiety and depression. Participants' physical activity levels were assessed for seven days via  
17 accelerometry. Participants completed the same measures six months later (semester 2).  
18 **Results:** Daily moderate physical activity levels decreased across the semesters yet  
19 perceptions of mental well-being remained stable. There was a significant increase in hip and  
20 waist circumferences across the semesters. **Conclusions:** First year of university is a critical  
21 period for establishing positive health behaviours and there is a need for universities to  
22 actively encourage physical activity as an integral part of university life.

23 **Keywords:** higher education, physical activity, university, students, mental well-being,  
24 health

## 25 **Introduction**

26 The physical and mental health benefits of engaging in regular physical activity are well  
27 established for adults (Reiner et al. 2013, Teychenne, Ball, and Salmon 2008). However  
28 physical activity levels in young adults decline between the ages of 18 and 24 (Leslie et al.  
29 2001) which coincides with a period where many young adults are involved in higher  
30 education. In 2004, Haase et al. (2004) conducted a cross-sectional survey examining the  
31 leisure-time physical activity levels of 19,298 university students from 23 countries varying  
32 in culture and level of economic development. Comparative to data in the United States (US)  
33 and Australia, data examining physical activity levels of university students in the United  
34 Kingdom (UK) highlighted that 73% of males and 79% of females did not meet the physical  
35 activity guidelines at the time. Since then, UK physical activity guidelines for adults have  
36 been updated to a minimum of 150 minutes of moderate intensity physical activity over seven  
37 days (Department of Health 2011). Therefore, despite previous research indicating high  
38 levels of inactivity amongst the student population in several countries, these data are dated  
39 and comparative to previous guidelines; based on a cross-sectional survey accounting solely  
40 for leisure-time physical activity and are only representative of university students in  
41 England. Furthermore, studies that have compared the physical activity levels of students  
42 using subjective and objective measurement tools have shown that students may overestimate  
43 their physical activity levels (Bray and Born 2004, Loney et al. 2011, Downs et al. 2014)  
44 which suggests students perceive themselves to be engaging in desirable health behaviours  
45 whilst objective data suggests this may not be the case.

46 During the transition from school to higher education, young adults experience a  
47 substantial amount of change where they progress from the highly controlled setting of  
48 school to the autonomous and self-motivated environment of university (MacNamara and

49 Collins 2010). This shift in independence allows students more choice and control over a  
50 range of health behaviours, including physical activity (Bray and Born 2004). Research has  
51 suggested that relocation to on-campus accommodation in first year at university could  
52 further contribute to a reduction in students' physical activity levels. A systematic review by  
53 Irwin (2004) compared the physical activity levels of 35,747 students living on-campus and  
54 off-campus across 27 countries. The authors concluded that overall those students who lived  
55 on campus were less active than those who lived off campus, suggesting that the campus  
56 environment is a key determinant of physical activity choices and behaviours. More recent  
57 findings (King et al. 2011) also showed a larger reduction ( $M = -47\%$ ) in physical activity  
58 levels in those students who relocated to on-campus accommodation compared to those  
59 students who did not relocate ( $M = -33\%$ ). However all data available comparing the physical  
60 activity levels of students who reside on-campus and off campus are gathered using  
61 subjective measures and there are limited data for UK university students, particularly those  
62 that attend universities outside of England.

63 In order to address low levels of physical activity amongst students, several health  
64 promoting university initiatives have been implemented in recent years (e.g., Freshman 5 to  
65 Thrive: Creating Opportunities for Personal Empowerment and Healthy Lifestyles; Melnyk et  
66 al. 2014). McDaniel, Melton, and Langdon (2014) developed a Physical Activity Passport  
67 (PAP) as part of an intervention to increase students' physical activity levels through  
68 combining student life with academics. The PAP intervention was implemented as a  
69 university assignment where printed physical activity logs recorded physical activity levels  
70 that were signed off by fitness class instructors or sports captains, with the aim to increase  
71 physical activity levels outside academic study. Findings identified that those students who  
72 took part in the PAP intervention attended four times as many group fitness classes ( $M =$   
73  $6.98$ ,  $SD = 0.38$  number of fitness classes/week) than those students who were in the control

74 group ( $M = 1.48$ ,  $SD = 0.26$  number of fitness classes/week). Encouraging students to adopt  
75 an active lifestyle through such initiatives whilst at university could help them develop  
76 autonomy over health behaviours.

77 In addition to the potential relocation from home, the transition from school to  
78 university involves a number of changes that can impact on the mental well-being of students  
79 including financial concerns, academic pressures and a lack of social support. It could be  
80 argued that the financial concerns associated with tuition fees, living costs and associated  
81 costs of studying can be a significant source of stress for many students (Nelson et al. 2008,  
82 Lange and Byrd 1998). In 2010 the National Union of Students in Scotland released a report  
83 on Scottish students' mental well-being (Scotland 2010). The survey was completed by over  
84 1800 students from 19 colleges and 15 universities across Scotland and 'having enough  
85 money for day to day living' was reported as a key source of stress for almost 70% of  
86 students. In the report, academic pressures such as exams and assessments were reported as  
87 the greatest source of stress for university students with over 90% of students stating  
88 academic pressures caused them more stress than expected.

89 Studying at university offers the opportunity to establish new social networks for  
90 many young adults yet the pressure to make friends and integrate into university life could be  
91 a source of worry and anxiety. Longitudinal survey data on the prevalence of mental health  
92 problems in a sample of 763 US college students was collected by Zivin et al. (2009).  
93 Findings indicated that over the two year period, over one third of the sample had a mental  
94 health problem and this persisted in 60% of the sample during their time at college. This is  
95 comparable to UK data where Berwick and colleagues (Bewick et al. 2010) reported temporal  
96 changes in psychological well-being of UK students at pre-registration and progression  
97 throughout their university degree. The highest levels of anxiety were reported in semester

98 one of second year and anxiety levels did not reduce to levels measured initially at pre-  
99 registration. Although consistently lower than the reported levels of anxiety across the three  
100 years, levels of depression steadily increased, with the highest levels of depression reported  
101 in semester two of third year with levels almost double that reported at pre-registration.  
102 Overall the results suggest that university is predominately an anxiety-provoking rather than a  
103 depressive time and levels of anxiety and depression at university are overall higher than  
104 prior to entering higher education.

105         The health of the student population is a public health concern as the transition from  
106 late adolescence to adulthood is accompanied by a time of increased personal choice, and  
107 behaviours adopted during this time may develop into long-term habits. This coincides with a  
108 period of change where financial concerns and academic and social pressures can cause  
109 psychological distress for students as they enter university. It is well established that  
110 engaging in regular physical activity can improve psychological well-being and should be  
111 considered as an important part of university life. The overall aim of the study was to  
112 examine the physical activity levels and mental well-being of Scottish students during their  
113 first year at university. A secondary aim was to examine the effect of gender and living  
114 environment (i.e. on-campus vs. off-campus) on physical activity levels and mental well-  
115 being.

## 116 **Methods**

### 117 **Participants**

118         Participants were 52 students (males, n = 26; females, n = 26) aged 18-19 years (M =  
119 18.5 ± 0.8) in their first year of undergraduate degree programmes at two Scottish universities  
120 in the UK. Participants were recruited through poster advertisement at both universities,

121 email distribution lists and through word of mouth. The study was granted institutional  
122 ethical approval and written informed consent was provided before data collection began with  
123 additional verbal information given to participants on the first visit to the laboratory. The first  
124 phase of data collection took place during the first academic semester of first year (September  
125 2013), referred to as ‘Semester 1’. The second phase of data collection took place at the  
126 beginning of the second academic semester of first year (January 2014), referred to as  
127 ‘Semester 2’.

## 128 **Procedures**

129 The study procedures involved two visits to the university laboratory in each  
130 semester. On the initial visit participants provided informed consent and were then asked to  
131 complete a demographic questionnaire and the Hospital Anxiety and Depression Scale  
132 (HADS)(Zigmond and Snaith 1983). Participants’ height, mass, blood pressure, waist and hip  
133 circumference were then assessed. Once participants completed all questionnaires and  
134 physical assessments, they were fitted with a tri-axial accelerometer (GT3x Actigraph) and  
135 instructed on how to wear it. Participants were asked to wear the accelerometer for 7 days to  
136 assess the frequency, duration and intensity of their daily activity. After the 7 days, the  
137 participants visited the laboratory to return their accelerometer and non-wear time log diary.  
138 Participants also completed the International Physical Activity Questionnaire (IPAQ)(Craig  
139 et al. 2003) to assess their self-reported moderate and vigorous physical activity levels during  
140 the previous week.

## 141 **Measures**

142 Demographic variables

143 Participants were asked to complete a demographic questionnaire to assess gender,  
144 age, ethnicity, undergraduate degree course and current living environment. Students who  
145 lived in university halls of residence were categorized as ‘living on-campus’ and those who  
146 remained living at home or lived in alternative accommodation were categorized as ‘living  
147 off-campus’. A majority of the student sample lived in on-campus accommodation (n= 37:  
148 71.2%) compared to the amount that lived in off-campus accommodation (n= 15: 28.8%). For  
149 all the students included in the study neither the living environment nor the academic course  
150 being studied changed from semester 1 to semester 2.

#### 151 Psychological well-being

152 The HADS (Zigmond and Snaith 1983) is a self-report questionnaire used frequently  
153 to assess anxiety and depression, which requires participants to recall how they have felt in  
154 the previous week. The HADS comprises a 14-item scale with seven questions relating to  
155 anxiety and seven questions relating to depression. Answers consist on a four point Likert  
156 scale; 0= not at all, 1= not often, 2= quite a lot, 3= definitely. Scores are summed where a  
157 score of 0-7 signifies no presence of clinical symptoms; 8-10 indicates mild symptoms; 11-14  
158 demonstrates moderate symptoms of depression and anxiety and a score of 15-21 indicates  
159 severe symptoms. Published UK normative data (Crawford et al. 2001) reported a HADS  
160 depression score as 3.68 and HADS anxiety score as 6.14 out of a maximum score of 21.  
161 Previous research suggests that the HADS is a widely used and valid measure of depression  
162 and/or anxiety (Bjelland et al. 2002).

#### 163 Physical measurements

164 Physical assessments included recording of participants’ height, mass, blood pressure,  
165 hip and waist circumference. Height was recorded using a Stadiometer (Model 225, Seca Ltd)



166 and mass was assessed using precision scales (Model 770, Seca Ltd). Participants' systolic  
167 and diastolic blood pressures were recorded using an Omron 2 automatic blood pressure  
168 monitor, which was placed on the participant's relaxed left upper arm. Waist and hip  
169 circumferences were measured using a tape measure and participants were asked to position  
170 their feet together to ensure consistency in measurements. Waist and hip circumferences were  
171 measured in accordance with the International Society for the Advancement of  
172 Kinanthropometry standardized protocols.

### 173 International Physical Activity Questionnaire

174 Participants were asked to complete the IPAQ (Craig et al. 2003) which is used to  
175 assess the physical activity levels of participants over the previous 7 days. The IPAQ  
176 assesses physical activity undertaken across a comprehensive set of domains including leisure  
177 time, domestic and gardening activities, work-related and transport-related activity. The  
178 specific types of activity that are assessed are walking, moderate intensity activities and  
179 vigorous intensity activities. Frequency (measured in days per week) and duration (time per  
180 day) are collected separately for each specific type of activity. Previous research confirms the  
181 IPAQ to have good construct validity when used alongside objective physical activity  
182 monitors and self-report diaries (Hagstromer, Oja, and Sjostrom 2006).

### 183 ActiGraph Accelerometer

184 A 19g tri-axial accelerometer GT3X+ (ActiGraph, LLC, Pensacola, FL, USA) was  
185 used to assess the participants' objective physical activity levels through measuring  
186 frequency, intensity and duration of activity. The accelerometer was attached to an adjustable  
187 elastic belt and worn on the participant's right hip for 7 consecutive days. Each participant  
188 was provided with thorough instruction on how to wear the ActiGraph and asked to fill in an

189 activity log to provide detail on when the device was removed (non-wear time) on each of the  
190 7 days. The Freedson Adult VM3 (Sasaki, John, and Freedson 2011) cut points were used to  
191 determine the intensity of the activity being undertaken, measured as counts per minute  
192 (CPM). Activity monitors were set to a sample rate of 10-second epochs, in accordance with  
193 previous research (Troost, McIver, and Pate 2005) and non-wear time was counted as 60  
194 consecutive minutes with zero counts and excluded from further analysis. Data were included  
195 if the participants had accumulated a minimum of 10 hours of valid activity recordings per  
196 day for at least 4 of the 7 days, which is in accordance with similar studies (Troost, McIver,  
197 and Pate 2005, Hagstromer et al. 2010).

## 198 **Data Analysis**

199 All data were screened for normal distribution and homogeneity of variance and  
200 significance was accepted at  $p < 0.05$ . Participants' objective accelerometer data were  
201 screened for any outliers to exclude any days that did not meet the inclusion criteria, resulting  
202 in the exclusion of four participants from the data analysis. Therefore comparisons between  
203 semester 1 and semester 2 were made on a sample of 48 male and female first year students.

204 Paired sample T-tests were used to examine changes in subjectively- and objectively-  
205 measured physical activity, physical characteristics, anxiety and depression between semester  
206 1 and semester 2. A two-factor repeated-measures ANOVA was conducted to examine the  
207 influence of gender and living environment on calculated delta values (semester 1-semester 2  
208 differences) in physical activity, physical characteristics, anxiety and depression. Effect sizes  
209 were estimated using Cohen's  $d$  (Cohen 1988) interpretation guidelines of  $d \geq 0.2$  (small  
210 effect size),  $d \geq 0.5$  (medium effect size) and  $d \geq 0.8$  (large effect size).

## 211 **Results**

## 212 **Changes in physical activity**

213 Accelerometer data across both semesters is provided in Table 1. There was an overall  
214 significant decrease in time spent in moderate intensity physical activity (average daily  
215 minutes) from semester 1 to semester 2 ( $t = 4.701$ ,  $df = 47$ ,  $p < .001$ ). The mean difference  
216 between semester 1 and semester 2 was 10.8 minutes and the 95% confidence interval for the  
217 estimated population mean was between 15.4 minutes and 6.2 minutes. The effect size was  
218 small ( $d = 0.1$ ). There was an overall increase in light intensity physical activity (percentage  
219 of daily physical activity) from semester 1 to semester 2 ( $t = 3.195$ ,  $df = 47$ ,  $p < .05$ ). The  
220 mean difference between semester 1 and semester 2 was -0.9% and the 95% confidence  
221 interval for estimated population mean difference was between -0.4% and -1.5%. The effect  
222 size was small ( $d = 0.3$ ). There was an overall decrease in the percentage of time spent in  
223 moderate intensity physical activity (percentage of daily physical activity) from semester 1 to  
224 semester 2 ( $t = 3.949$ ,  $df = 47$ ,  $p < .001$ ). The mean difference between semester 1 and  
225 semester 2 was 1.0% and the 95% confidence interval for the estimated population mean was  
226 between 1.5% and 0.5%. The effect size was medium ( $d = 0.5$ ).

227 **\*\* Insert Table 1 here\*\***

228 Table 2 shows the self-report physical activity data based on the IPAQ. There were no  
229 significant differences between semester 1 and semester 2 in any of the IPAQ activities  
230 (walking; moderate physical activity; vigorous physical activity and total physical activity) or  
231 in any of the domains assessed by the IPAQ (work; transport, domestic; leisure).

232 **\*\*Insert Table 2 here\*\***

## 233 **Changes in physical characteristics**

234           There was a significant increase in waist circumference ( $t = 3.719$ ,  $df = 47$ ,  $p < .001$ )  
235 from semester 1 ( $M = 74.3\text{cm}$ ;  $SD = 6.7$ ) to semester 2 ( $M = 76.2\text{cm}$ ;  $SD = 6.4$ ). The mean  
236 difference between semester 1 and semester 2 was  $+1.9\text{cm}$  and the 95% confidence interval  
237 for the estimated population mean difference was between  $+0.9\text{cm}$  and  $+2.9\text{cm}$ . The effect  
238 size was small ( $d = 0.3$ ). There was also a significant increase in hip circumference ( $t =$   
239  $3.263$ ,  $df = 47$ ,  $p < .01$ ) from semester 1 ( $M = 95.3\text{cm}$ ;  $SD = 7.1$ ) to semester 2 ( $M = 97.0\text{cm}$ ;  
240  $SD = 7.0$ ). The mean difference between semester 1 and semester 2 was  $+1.7\text{cm}$  and the 95%  
241 confidence interval for the estimated population mean difference was between  $+0.6\text{cm}$  and  
242  $+2.7\text{cm}$ . The effect size was small ( $d = 0.2$ ). There were no significant differences between  
243 semester 1 and semester 2 for height, mass, systolic and diastolic blood pressure.

#### 244 **Changes in anxiety and depression**

245           There was a significant decrease in anxiety levels ( $t = 5.387$ ,  $df = 47$ ,  $p < .001$ ) from  
246 semester 1 ( $M = 6.8$ ;  $SD = 3.9$ ) to semester 2 ( $M = 4.4$ ;  $SD = 2.4$ ). The mean difference  
247 between semester 1 and semester 2 was  $2.4$  and the 95% confidence interval for the estimated  
248 population mean difference was between  $3.3$  and  $1.5$ . The effect size was large ( $d = 0.8$ ).  
249 There was no significant difference in levels of depression from semester 1 to semester 2.

#### 250 **Influence of gender and living environment on changes in physical activity, physical** 251 **characteristics, anxiety and depression**

252           There were no main effects or interaction effects evident for gender and/or living  
253 environment on the delta values of the outcome variables.

#### 254 **Discussion**

255 Accelerometer data collected in semester 1 and semester 2 suggests that these students  
256 were exceeding the current UK physical activity guidelines (Department of Health 2011)  
257 accumulating nearly 60 minutes of daily moderate to vigorous physical activity (MVPA).  
258 This is an encouraging finding yet needs to be interpreted with caution. Previous research has  
259 identified the potential of reactivity which can often lead to temporary increases in physical  
260 activity among individuals wearing an accelerometer for a period of 7 days (Motl, McAuley,  
261 and Dlugonski 2012). The finding contradicts recent accelerometer data collected in a  
262 sample of US college students (Downs et al. 2014) where only 33% of the sample (n = 72)  
263 were meeting US physical activity guidelines, accumulating 20 minutes of daily MVPA.  
264 However it is important to note that the data were collected over a period of 14 days (Downs  
265 et al. 2014) which may have reduced the likelihood of reactivity compared to the 7 day  
266 measurement period in our study.

267 Over the six month period, there was a significant decrease in the amount of time  
268 spent in moderate physical activity and a significant increase in time spent in light physical  
269 activity. This suggests that students may be spending more time in light intensity physical  
270 activity to the detriment of engaging in moderate physical activity. Whilst this was only  
271 examined over two time points in their first year at university, a continuous trend in  
272 decreasing daily moderate intensity physical activity could reduce the potential of the  
273 associated health benefits of moderate physical activity during their time spent at university.  
274 There is limited comparative objective longitudinal data on student physical activity levels  
275 yet there is partial evidence of a shift in the type and intensity of activity students participate  
276 in whilst at university (Racette et al. 2005).

277 Self-report data based on the IPAQ provided partial support for the accelerometer  
278 data. Although not statistically significant, students' perceptions of time spent in moderate

279 and vigorous physical activity decreased across the two semesters and overall daily physical  
280 activity decreased. This suggests that students are meeting the current UK physical activity  
281 guidelines yet are overestimating the amount of time spent in daily vigorous physical activity  
282 (M = 42.1mins) when compared to the objective data of the accelerometer (M = 8.1mins).  
283 Overestimation of duration and intensity of physical activity is commonplace when relying  
284 on self-report measures (Montoye et al. 1996). Similar findings were reported by Downs and  
285 colleagues (Downs et al. 2014) in their sample of 72 US students who reported spending 68  
286 minutes per day in MVPA yet accelerometer data estimated they spent 20 minutes per day in  
287 MVPA. Overall the findings point towards a need for surveillance data in this population to  
288 consider the inclusion of objective assessment methods and for health promotion initiatives  
289 within universities to increase knowledge and awareness of the intensities of activities that  
290 are offered to students.

291 Weight gain amongst students, particularly during the freshman year, has been studied  
292 extensively in the US and Canada (Holm-Denoma et al. 2008, Pullman et al. 2009, Racette et  
293 al. 2008) reporting increases in body mass and body mass index in this population. In this  
294 study, there were significant increases in waist and hip circumference over the six months.  
295 Our findings share similarities with previous literature looking at changes in body  
296 composition during the initial stages of university study. Body composition was assessed in  
297 120 students in their freshman year and then in their sophomore year (Gropper et al. 2011)  
298 and results indicated a significant increase in waist circumference (M = +0.9cm), comparable  
299 to the increases reported in our study (M = +1.9cm). Increases in weight gain and waist and  
300 hip circumference could be attributed to the reduced time spent in moderate physical activity  
301 or changes in dietary habits, however dietary habits were not monitored in the current study.  
302 These significant increases in anthropometric measurements in a six month period is  
303 concerning and need to be prioritised in health promotion initiatives targeting students.

304 For young adults, the transition to university is a period characterised by change,  
305 uncertainty and adjustment in several aspects of their lives (e.g., financial, social, academic)  
306 with the potential to impact upon their psychological well-being (Bray and Born 2004). In the  
307 current study, levels of anxiety significantly decreased from semester 1 to semester 2,  
308 perhaps suggesting that initial entry to university is an anxiety provoking time yet anxiety  
309 lessens as students adjust to their new environment. Similar findings have been documented  
310 in a study examining the temporal nature of psychological well-being of 4,699 students  
311 entering their first year at university in the UK (Cooke et al. 2006). Data were collected over  
312 four time-points (pre-entry to university; one-month after entry; end of semester 1; end of  
313 semester 2) and indicated that levels of anxiety were heightened upon initial entry to  
314 university when compared to both pre-entry to university levels and levels of anxiety at the  
315 end of semester 2. In the current study, reported levels of depression did not significantly  
316 increase across the two semesters and depression scores were comparatively low in relation  
317 to levels of anxiety. This was also evident in the data collected by Cooke and colleagues who  
318 suggested that the first year of university is a time of heightened anxiety yet not a particularly  
319 depressive time for students. Overall the findings reinforce the need for universities to  
320 monitor changes in the psychological well-being of students during their time at university  
321 and to provide adequate support for first year students as this appears to be a period of critical  
322 adjustment where they experience increased levels of anxiety.

323 Previous research has suggested that a change in the physical environment could  
324 impact on the physical activity levels of students (Irwin 2004, Kapinos and Yakusheva 2011,  
325 King et al. 2011) and that students living on campus were less active than those living in off-  
326 campus accommodation (Irwin 2004). Yet recently, a study examining how living on or off  
327 campus is associated with dietary and physical activity patterns in college students across  
328 seven semesters found that living off campus exacerbated decreases in physical activity and

329 poor dietary consumption (Small et al. 2013). Contrary to the above studies, we found that  
330 the decrease in physical activity levels, increase in waist and hip circumference and decrease  
331 in anxiety levels were not influenced by living environment. It is important to note that the  
332 majority of the sample lived on-campus which may have limited the possible influence of  
333 living environment and needs further consideration. Contrary to a recent longitudinal study  
334 (Deforche et al. 2015) examining changes in body mass, physical activity, sedentary  
335 behaviour and dietary intake during the transition to higher education in 291 students, we also  
336 found no main effect of gender in any of the changes in the outcome measures across the two  
337 semesters yet physical activity was not assessed using an objective method, which makes it  
338 difficult to draw comparisons.

339           Whilst the study had identifiable strengths in the longitudinal assessment of the  
340 physical activity levels in first year students based at two universities using objective and  
341 subjective measures, there were also limitations. Our sample represented a very small  
342 proportion of the first year students at the universities who self-selected for the study and  
343 only included full-time undergraduate students, which limit any generalisations that can be  
344 made for part-time students. Gaining a detailed understanding of the entry to university as a  
345 transition experience requires us to examine behaviours prior to starting university. Similarly,  
346 longitudinal assessment of physical activity, anxiety and depression beyond first year at  
347 university would provide a clearer representation of temporal fluctuations in these health  
348 outcomes across time spent at university. Finally, it would be useful to compare the health  
349 behaviours of students with those of young adults who enter employment, as opposed to  
350 attending university, to determine the impact of university life on student health and well-  
351 being.

## 352 **Conclusions**



353 Higher education institutions are an appropriate setting to promote healthy lifestyles  
354 yet the transition to university is a period characterised by change, uncertainty and adjustment  
355 that can have a negative impact on health and well-being. Our findings indicated that daily  
356 moderate physical activity levels decreased across the semesters in first year and that students  
357 spent more time engaging in light intensity activities in semester 2. There were also increases  
358 in waist and hip circumference during their first year at university yet these changes were not  
359 influenced by gender or living environment. Future research could explore other potential  
360 predictors of the change in physical activity levels during first year. Unfavourable changes in  
361 physical activity levels and physical characteristics in our first year student sample over a  
362 relatively short period of time (six months) are therefore concerning. There is a need for  
363 universities to actively encourage physical activity as an integral part of university life,  
364 providing opportunities for physical activity and to enhance students' knowledge on the  
365 importance of MVPA. Entry to university appeared to be a time of heightened anxiety for our  
366 student sample yet levels of depression reported were comparably low. Signposting students  
367 to the relevant support services upon entry to university is recommended to assist students  
368 during this transitional period. It was also apparent that psychological well-being is  
369 changeable even over a short period of time and needs to be monitored throughout time spent  
370 at university, to allow the provision of appropriate and timely intervention.

371

372 **Table 1.** Daily accelerometer physical activity data across semesters 1 and 2

	<b>Semester 1 (n = 48)</b>		<b>Semester 2 (n = 48)</b>	
	M	SD	M	SD
Total time in activity (mins)	867.9	59.0	845.4	64.8
Light activity (mins)	794.2	52.3	782.3	66.5
Moderate activity (mins)	64.8	21.9	54.0**	17.6
Vigorous activity (mins)	8.0	8.8	8.2	7.6
Very vigorous activity (mins)	1.1	1.3	1.0	1.5
% time in light activity	91.6	2.8	92.5*	2.5
% time in moderate activity	7.4	2.3	6.4**	2.1
% time in vigorous activity	0.9	1.0	0.9	0.8
% time in very vigorous activity	0.1	0.1	0.2	0.1

373 \*p<.05; significant difference between semesters

374 \*p<.001; significant difference between semesters

375 **Table 2.** Daily self-report physical activity data across semesters 1 and 2

	<b>Semester 1 (n = 48)</b>		<b>Semester 2 (n = 48)</b>	
	M	SD	M	SD
Total activity (mins)	156.3	104.4	144.9	91.0
Walking (mins)	70.4	44.6	72.2	44.9
Moderate (mins)	40.3	54.1	34.2	38.3
Vigorous (mins)	45.7	39.2	38.5	28.7
Work-related activity (mins)	22.2	55.1	19.4	43.6
Transport-related activity (mins)	51.1	31.2	49.5	34.4
Domestic-related activity (mins)	15.1	19.3	15.6	22.2
Leisure-related activity (mins)	68.0	47.0	60.4	36.8

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