

## Active students are healthier and happier than their inactive peers: The results of a large representative cross-sectional study of university students in Ireland

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1 **Abstract**

2 **Background:** Time spent in university represents a period of transition and may be an appropriate  
3 time to promote physical activity amongst young adults. The aim of this study was to assess  
4 participation of university students in sport and physical activity in Ireland and explore the association  
5 between physical activity and perceptions of overall health, mental health and happiness.

6 **Methods:** The Student Activity and Sport Study Ireland (SASSI) was a cross-sectional online survey  
7 among a representative sample (n=8,122) of university students in Ireland. Binary logistic regressions  
8 were performed to examine associations between self-reported physical activity and gender (predictor  
9 variables) and individual perceptions of overall health, mental health and happiness (binary  
10 outcomes).

11 **Results:** 64.3% of respondents met the recommended level of 150 minutes of moderate-to-vigorous  
12 physical activity per week with males significantly more active than females (72.1% vs 57.8%  
13 meeting guidelines). Those meeting physical activity guidelines were more likely to report greater  
14 overall health and higher mental health and happiness scores compared with their inactive peers.

15 **Conclusion:** Active students enjoy better health (overall and mental), and are happier than their  
16 inactive peers. This provides a clear rationale for providing students with opportunities to be active at  
17 university. The data provides a baseline to monitor changes in physical activity patterns.

18

19

## 20 **Introduction**

21 Physical activity is associated with multiple health benefits across the life course,<sup>-3</sup> Regular activity  
22 has been shown to play a role in the primary and secondary prevention of cancer, cardiovascular  
23 disease, diabetes, osteoporosis and obesity.<sup>2</sup> In addition to these physical health benefits, regular  
24 participation in physical activity is associated with a range of positive mental health related  
25 outcomes,<sup>4</sup> including reduced anxiety, stress and depression<sup>2,5</sup> enhanced cognitive function and  
26 academic performance.<sup>6</sup>

27 Despite the health benefits of regular participation, approximately one third (31.1%) of adults are  
28 physically inactive.<sup>7</sup> The transition from adolescence to adulthood,<sup>8</sup> and in particular the transition to  
29 college/university provides an opportunity for influencing adult behaviour.<sup>9</sup> Young adults are exposed  
30 to a number of academic, physical, emotional and social changes<sup>10</sup> which coupled with changes in  
31 independence, and living situations amongst some students, may influence key health behaviours,  
32 such as alcohol use, nutrition and physical activity.<sup>9</sup>

33 Physical activity levels decline as adolescents make the transition into adulthood.<sup>8,11,12</sup> Furthermore,  
34 males entering university education may be most at risk from sharp declines in physical activity  
35 compared with those not continuing in education.<sup>8</sup> A meta-analysis has highlighted that 40-50% of  
36 college students are physically inactive.<sup>13</sup> Although self-reported PA levels of school children and  
37 working adults have been well documented,<sup>7,14</sup> there is less information on university students'  
38 physical activity engagement, and few are based on representative or random samples.<sup>13,15,16</sup>

39 In addition to inactivity, the transition to university is associated with increased exposure to other  
40 health risk behaviours such as poor dietary intake and substance abuse.<sup>9</sup> Research has indicated that  
41 while individuals 'grow out' of health risk behaviours such as smoking and binge drinking as they  
42 progress from adolescence, such positive changes are typically not seen in physical activity  
43 behaviours.<sup>8</sup>

44 Approximately 1 in 5 young adults (aged 19-24 years) in Ireland experience mental health problems.<sup>17</sup>  
45 College students may be at increased risk from mental health disorders, with higher prevalence

46 reported compared with the general population.<sup>18</sup> Indeed Hunt et al (2010) report an increase in both  
47 the prevalence and severity of mental health disorders amongst college students.<sup>19</sup> In addition to the  
48 negative impact mental health disorders can have on overall health, such problems may also impact  
49 academic performance.<sup>20</sup>

50 It is well established that regular physical activity can have a positive impact on mental health related  
51 outcomes in adults,<sup>4</sup> reducing depressive symptoms and improving emotional wellbeing.<sup>5,21</sup> Evidence  
52 has also demonstrated an association between higher levels of physical activity and higher levels of  
53 happiness.<sup>22</sup> Studies in student populations have demonstrated a link between physical activity and  
54 reduced symptoms of stress<sup>23,24</sup> and fewer reports of poor mental health.<sup>24</sup> Much of this has been in  
55 North American populations, and focused on vigorous physical activity as opposed to health  
56 enhancing moderate-to-vigorous physical activity (MVPA). Given the low prevalence of physical  
57 activity and high prevalence of mental health problems in young Irish people, the relationship  
58 between MVPA and mental health related outcomes in college students warrants further investigation.

59 The increasing proportion of the population now progressing to university level education is reflective  
60 of the transition of Ireland from a middle income to high income country between 1987 and 2000.<sup>25</sup>  
61 According to Eurostat data, almost 58% of Irish women have completed third-level education  
62 compared to 44% of Irish men in 2012, with these levels the highest in Europe.<sup>26</sup> The potential of  
63 colleges to influence uptake and maintenance of physical activity behaviours, and influence other  
64 related outcomes, such a mental wellbeing and happiness, is vast. There is limited data available on  
65 the physical activity levels of college students across the island of Ireland, and population surveillance  
66 is outlined as a key objective within the national physical activity plan.<sup>27</sup> Furthermore, the  
67 development of a framework for health promoting colleges to include physical activity was included  
68 as an action point within the national plan,<sup>27</sup> highlighting the role that universities and colleges can  
69 play in promotion physical activity and other aspects of student wellbeing.

70 The aim of this paper was to assess the participation of university students in Ireland in sport and  
71 physical activity and to explore to what extent physical activity is associated with overall health,  
72 mental health and happiness.

## 73 **Methods**

### 74 Study design

75 The Student Activity and Sports Participation Survey Ireland (SASSI) was a three-phase study  
76 commissioned by Student Sport Ireland (SSI) to investigate sports and physical activity participation,  
77 preferences and provision in colleges/universities on the island of Ireland. The methods and results  
78 contained within this paper include Phase 2 of the study; a cross-sectional analysis of university  
79 students across the island of Ireland in 2014-2015. An audit of the environment and institutional  
80 provision for sport and physical activity comprised Phase 1, and objective fitness measures were  
81 undertaken on a subsample of students in Phase 3.

### 82 Sampling

83 In order to achieve a nationally representative sample, student data obtained from the Higher  
84 Education Academy (HEA) (Republic of Ireland)<sup>28</sup> and Department of Employment and Learning  
85 (Northern Ireland),<sup>29</sup> enrolments within each institution were categorised into 10 'fields of study'. In  
86 each institution random sampling of student groups was undertaken in proportion to the numbers of  
87 students studying at each year of study (including undergraduate and postgraduate) within each 'field  
88 of study'. Once the sampling framework was applied to identify groups of students by year and field  
89 of study, all students attending the selected class were eligible for inclusion. Forty-one Higher  
90 Education Institutions were contacted to participate in the Phase II SASSI Student Survey. Thirty one  
91 institutions responded, 4 declined to participate, 5 did not respond to contact, and 1 used an  
92 unapproved protocol (emailing the survey link to all students in the institution). From the 31  
93 participating institutions the total quota sought was 10,606.

### 94 Study procedure

95 Each institution assigned a 'SASSI champion' who was trained to facilitate recruitment and data  
96 collection. The SASSI champion was provided with a list of randomly selected class groups within  
97 their institution and sought permission from teaching staff within their institution to access the group  
98 during class time, either before the lecturer commenced or at the end of the lecture before the students

99 were dismissed. In order to maximise response, the online survey was administered through  
100 SurveyMonkey to the entire class group (chosen using an online random number generator) in the  
101 appropriate year group and field of study during a timetabled hour. Surveys were either completed by  
102 students using a computer suite on campus or by using their own devices during regular (non-  
103 computer based) classes. Students were not able to access and complete the survey remotely using a  
104 weblink to reduce the likelihood of self-selection bias.

105 The survey took approximately 20 minutes to complete. All surveys were completed between October  
106 and December 2014. The institutional champion introduced the survey outlining the objectives and  
107 assuring anonymity of responses. Survey completion was incentivised within each institution by entry  
108 into a prize draw could be exchanged for purchases at a range of retail stores or food outlets. The  
109 value of the prize varied by institution but was > €100. One prize was provided by each institution. In  
110 order to verify that sampling by the champion took place as directed, the date stamps of responses was  
111 examined for each institution. Where the majority (> 90%) of responses occurred in batches and  
112 within normal college hours it was deemed likely that the survey administration protocol was adhered  
113 to.

#### 114 Student Survey

115 The student survey was developed to assess students' participation in sport and physical activity,  
116 perception of the institutional sports and physical activity environment, the enablers and barriers to  
117 participation (correlates), performance support for high level and scholarship athletes, related health  
118 behaviours and other demographics. Survey items were derived, where possible, from existing  
119 validated instruments. Items were selected in consultation with the SSI Research Management Group  
120 and advice was sought from three international experts with considerable expertise in the design and  
121 analysis of physical activity surveys. The survey was piloted amongst members of the research team,  
122 SASSI champions and students in 4 participating institutions, and amended accordingly based on  
123 feedback.

124 Ethical approval was granted by Ulster University and this approval was recognised by all  
125 participating institutions. Where this was not possible champions sought local ethical approval for the  
126 study from their institution's ethics committee.

127 Outcome measures

128 Demographics

129 Socio-demographic information included student background information (age and gender, field and  
130 year of study, full time or part time) and other demographics (ethnicity, marital status, socio-economic  
131 class (SEC), employment and accommodation).

132 Physical activity behaviours

133 Physical activity was measured using the International Physical Activity Questionnaire- Short Form  
134 (IPAQ-SF),<sup>30</sup> shown to be a valid and reliable measure of PA in this population.<sup>31,32</sup> Using the IPAQ  
135 Scoring Protocol, participants were categorised as "high", "moderate" or "low" active,<sup>33</sup> with  
136 individuals categorised as "high" active being deemed as meeting minimum physical activity  
137 requirements.<sup>34</sup> Participation in muscle strengthening activities was assessed using tools from the  
138 Children's Sport Participation and Physical Activity (CSPPA) Young Adult Study.<sup>35</sup> Student's  
139 knowledge of the physical activity guidelines was assessed using a modified question from the Health  
140 Survey for England.<sup>36</sup> Mode of transport to college/university was assessed using a single item tool  
141 previously used in the CSPPA Young Adult study.<sup>35</sup> In addition to overall levels physical activity  
142 students were asked about their participation in a range of organised sports and recreational physical  
143 activities. Respondents selected up to 5 activities and indicated the frequency, duration and intensity  
144 of these activities and whether they took place within and outside the college setting.

145 Sedentary behaviour

146 Domain specific sedentary behaviour was measured using a modified version of an instrument which  
147 has been assessed for gender specific test-retest reliability and validity.<sup>37</sup> The instrument required  
148 participants to estimate time spent sitting on weekdays and weekend days across 8 domains (attending

149 class, while studying, for transport, at work, using a computer, using a smartphone/tablet watching  
150 television and during leisure time). Time spent sitting in each domain was summed together to  
151 provide an overall daily total for hours spent in sedentary behaviour.

#### 152 Body mass index

153 Body Mass Index (BMI,  $\text{kg/m}^2$ ) was calculated using self-reported height and weight. Students were  
154 classified as underweight ( $<18.5$ ), normal weight ( $18.5 \leq \text{BMI} < 25$ ), overweight ( $25 \leq \text{BMI} < 30$ ) or  
155 obese ( $\text{BMI} \geq 30$ ) according to WHO references values.<sup>38</sup>

#### 156 Self-rated overall health

157 Self rated overall health was assessed using an item from the Short Form Health Survey (SF-36).<sup>39</sup>  
158 which asked respondents to rate their health over the past 12 months on a 5 point scale. Responses  
159 were dichotomised by grouping those reporting either average, poor, or very poor health, and those  
160 reporting very good or good health together.

#### 161 Happiness

162 Happiness was assessed on a 10 point Likert scale adapted from the Sport and Physical Activity  
163 Survey (SAPAS).<sup>40</sup> Responses were dichotomised into those with a score below 7 (the median  
164 average for happiness) and those with a score of 7 or above (happy).<sup>41</sup>

#### 165 Mental health

166 Mental health was assessed using the Mental Health Index (MH – 5), adopted from the SF-36  
167 questionnaire.<sup>39</sup> A single score was calculated for mental health from a 5 item index. Those with a  
168 score equal to or below the recommended cut off score of 52 were identified as having a ‘probable  
169 mental health problem’,<sup>42</sup> while a score above 52 was indicative of higher levels of positive mental  
170 health and well-being.

#### 171 Data analysis

172 Data analysis was conducted using IBM SPSS Statistics (Version 22). Descriptive statistics were  
173 derived to describe and summarise the dataset. Pearson's chi-squared tests of independence were  
174 applied to investigate the association between meeting the physical activity guidelines and gender and  
175 year of study. Binary logistic regressions were performed to examine the associations between self-  
176 reported physical activity (meeting the guidelines, moderately active or inactive), gender and  
177 individual perceptions of health, mental health and happiness. Binary outcome variables were health,  
178 mental health and happiness and the predictor variables were level of physical activity and gender.  
179 Probability was set at  $p < 0.05$ .

## 180 **Results**

### 181 Response rate

182 Thirty one colleges participated in the student survey. Of this, 14 colleges achieved their target quota,  
183 12 fell slightly below (within 10%) their target quota and five colleges exceeding their target. Given  
184 that the study focused on physical activity and sport, respondents who did not complete any questions  
185 focused on physical activity were regarded as non-responders, and removed from subsequent analysis.  
186 In total, 9,197 survey responses were collected, representing 87% of the target quota. Following the  
187 removal of non-responders, 8,122 survey responses were included in the analysis.

### 188 Demographics

189 The demographics of participants are in Table 1. Approximately half (50.9%) of respondents were  
190 female. The mean age of the sample was 23.17 years (SD 6.75). The majority of participants were  
191 from a white ethnic background (91.2%), with other ethnicities including Asian (4.3%), Black (1.9%),  
192 mixed/multiple (1.6) and other (1.1%). Respondents were mainly undergraduate students (92.4%)  
193 enrolled in full time courses (94.1%). Based on self-reported height and weight, 65.4% of respondents  
194 were classified as 'healthy weight' (BMI score between 18.5 and 24.9) (Table 1).

### 195 Physical activity levels

196 64.3% of participants met the minimum physical activity guidelines of 150 minutes MVPA per week.  
197 27.5% of participants were classed as 'moderately active' while 8.1% of participants were classed as  
198 inactive. Pearson's chi-squared tests indicated that males (71.2%) were more likely to be meeting the  
199 guidelines compared with females (57.8%) ( $\chi^2$  (2, n=7,421) = 0.139,  $p < 0.001$ ) (Figure 1). There were  
200 no differences in the proportion of students meeting the guidelines across each year of university  
201 ( $p = 0.307$ ). 50.1% of females and 31.9% of males reported undertaking no muscle strengthening  
202 activities in the past week.

203 Approximately one third (31.8%) of respondents felt that they were not undertaking 'enough physical  
204 activity to keep healthy'. A significant difference was observed between genders (24.2% of males  
205 compared with 38.9% of females,  $p < 0.001$ ). Over one quarter of students classified as inactive felt  
206 that they were sufficiently active for their health. Approximately one third of respondents (35.7%) felt  
207 they were doing the same level of activity as this time last year, with 30.9% reporting doing more  
208 activity and 30.7% reporting doing less activity.

209 31.5% of respondents correctly identified the physical activity guidelines as 'a minimum of 30  
210 minutes of physical activity per day', while 1.5% correctly identified 'at least 150 minutes per week  
211 of moderate to vigorous physical activity' as the volume and intensity of physical activity  
212 recommended to gain the associated health benefits. Females (39.3%) were significantly more  
213 knowledgeable about the physical activity guidelines than males (26.3%) ( $p = 0.010$ ).

214 40.3% of respondents stated that they actively commuted to college, either by foot (34.05) or bicycle  
215 (6.35%). Approximately one third (32.6%) of students usually travelled to college by car. Just over a  
216 quarter of respondents (26.8%) usually travelled to college using public transport; bus (19.6%) or  
217 train/tram (7.2%).

#### 218 Sporting and Recreational physical activity participation

219 Approximately one third (34.8%) of respondents did not participate in any sporting or recreational  
220 activity in the last 4 weeks. Differences between genders were also observed, with 28.4% of males not  
221 participating compared with 40.9% of females (Figure 2). The lowest levels of participation were

222 within college, where only 14.3% of respondents played sport. 18.3% participated inside and outside  
223 of college, and 32.5% reported participating only through outside organisations and facilities.

224 Weight training or cardio workouts were the most popular activities undertaken by respondents across  
225 all settings (i.e. inside and outside of college). Weight training, cardio workout and walking were  
226 identified as the three most popular activities undertaken within the college setting. Of the top 13  
227 sports identified within college, ten were individual activities (for example, walking, running,  
228 swimming).

#### 229 Sedentary behaviour

230 Respondents reported, on average, spending 12.1 hours (SD 7.37) per weekday engaged in sedentary  
231 behaviours (studying, attending class, watching TV, using computers etc.), compared with 10.1 hours  
232 (SD 8.67) on weekends. A higher proportion of respondents reported spending at least 8 hours per day  
233 engaged in sedentary behaviours on weekdays (71.2%) compared with weekends (55.8%). TV  
234 viewing, computer use and smartphone use was the largest contributor to overall sedentary time. Male  
235 students reported more non-education related sedentary screen time than females on both weekdays  
236 (4.3 hours.d<sup>-1</sup> vs 3.6 hours.d<sup>-1</sup>) and weekends (5.3 hours.d<sup>-1</sup> v 4.4 hours.d<sup>-1</sup>) (p<0.01).

#### 237 Associations between level of physical activity and health related outcomes

##### 238 Perceived general health

239 The majority of respondents (55.6%) reported their health as good or very good (Table 2). Those  
240 meeting the physical activity guidelines were 2.2 times more likely to report good or very good health  
241 than those classed as inactive (95% CI 1.839 - 2.712, p <0.001) (Table 3a). Furthermore, those classed  
242 as 'moderately' active were 35.6% more likely to report good or very good healthy (95% CI 1.104-  
243 1.666, p=0.004). Males were 22.9% more likely to report good or very good health compared with  
244 females (95% CI 1.109 – 1.361, p<0.001) (Table 3a).

##### 245 Mental health

246 The overall mean mental health score for respondents was 66.7 (SD 19.96). Based on the cut point of  
247 a mental health score  $\leq 52$ , 22.7% of students were categorised as having a 'probable mental health  
248 problem' (Table 2). Those meeting the physical activity guidelines were 55% more likely to report  
249 better mental health than those classed as inactive (95% CI 1.542-1.916,  $p < 0.001$ ) (Table 3b). Those  
250 classed as 'moderately' active were 23% more likely to report better mental health however this  
251 difference was not significant (95% 0.983-1.541,  $p = 0.070$ ). Males were also 23.3% more likely to  
252 report better mental health compared with females (95% CI 1.092-1.392,  $p = 0.001$ ) (Table 3b).

### 253 Happiness

254 The majority of respondents (64.7%) reported a high level of happiness (indicated by a score of 7 or  
255 above) (Table 2). Those meeting the physical activity guidelines were 2.2 times more likely to report  
256 feeling happy than those classed as inactive (95% 1.828-2.693,  $p < 0.001$ ) (Table 3c). Those classed as  
257 'moderately' active were 46.6% more likely to report higher happiness (95% CI 1.195-1.799,  
258  $p < 0.001$ ). No significant gender differences were observed for the association between physical  
259 activity level and reported happiness (95% CI 0.954-1.181,  $p = 0.276$ ) (Table 3c).

### 260 Discussion

261 The aim of this paper is to assess the participation of university/college students in sport and physical  
262 activity in Ireland and to explore whether physical activity is associated with health, mental health and  
263 happiness.

264 Within the present study, 64.3% of participants (72.1% males; 57.8% females) met the minimum  
265 physical activity guidelines of 150 minutes MVPA per week. Recent population level data from the  
266 Healthy Ireland survey reported 56% of men aged 15-24 years were achieving the physical activity  
267 guidelines, decreasing to 52% of men aged 25-34 years.<sup>43</sup> Consistent with SASSI findings, females in  
268 the general population were less likely to meet the guidelines than males, with 34% of women aged  
269 15-24 years and 32% aged 25-34 years meeting the guidelines.<sup>43</sup> This data highlights that  
270 university/college students in Ireland, particularly females, are considerably more active than their  
271 counterparts in the general population. In addition to the guideline for levels of MVPA, the SASSI

272 survey also highlighted low levels of muscle strengthening activities, with 50.1% of females and  
273 31.9% of males reported undertaking no muscle strengthening activities in the past week.

274 Approximately one third of students (35.7%) were not meeting the physical activity guidelines within  
275 the SASSI survey. A previous meta-analysis by Keating and colleagues highlighted inactivity levels  
276 in the range of 40-50% amongst students,<sup>13</sup> which is higher than the levels reported in the present  
277 study. Data across other countries have reported varying levels of inactivity amongst college students,  
278 with approximately half of students in the United States and Canada and approximately 40% of  
279 Australian students not meeting the guidelines for physical activity.<sup>16</sup> More recent data from Pengpid  
280 and colleagues has highlighted the wide variation, with the proportion of undergraduate college  
281 students categorised as inactive ranging from 22-81% across 23 countries.<sup>44</sup> The significant gender  
282 differences reported within the SASSI survey are consistent with previous research.<sup>45</sup>

283 Some of the inconsistencies in inactivity levels observed across studies may be attributed to the  
284 different measures employed within studies to measure physical activity levels.<sup>32</sup> Research by Downs  
285 and colleagues demonstrated that the use of the IPAQ may overestimate levels of MVPA by up to 45  
286 minutes per day compared with accelerometer derived data.<sup>46</sup> Within the SASSI study, moderate  
287 correlations were found between the IPAQ and accelerometer derived levels of MVPA, indicating that  
288 is a suitable tool for measuring physical activity amongst college students,<sup>32</sup> consistent with previous  
289 findings.<sup>31</sup>

290 The present study also assessed levels of sedentary behaviour amongst students, highlighting that a  
291 greater proportion of students were engaged in at least 7 hours per day of sedentary behaviour during  
292 weekdays (72.3%) compared with weekends (55.8%). Accelerometer derived sedentary behaviour has  
293 highlighted similar high levels of sedentary behaviour amongst UK adults.<sup>47</sup> Data on self-reported  
294 sitting time amongst the general population in Ireland indicated that young people aged 15-24 years  
295 spent the most time sitting (6.3 hours per day), with females aged 15-24 years found to be the most.<sup>48</sup> No  
296 significant differences were observed between sexes/genders within the present study. A review of  
297 the evidence from 3 systematic reviews concluded that although the heterogeneity of the measures  
298 used in studies of sitting and health outcomes make it difficult to draw conclusions about dose

299 response relationships the data suggests that those who sit for >8h per day have significant health risk  
300 <sup>49</sup> . With mean self reported sedentary time of 12.1 hours on weekdays and 10.1 hours on weekend  
301 days it is clear that this population of students are likely to be damaging their health through excessive  
302 time spent in sedentary pursuits.

303 Research to date on the relationship between physical activity and sedentary behaviours amongst  
304 college students has been inconsistent.<sup>50</sup> However, a number of correlates have been identified, for  
305 example, individual factors, social networks, the physical environment and advertising and media,  
306 which may influence both behaviours in college students.<sup>50</sup> Educational institutions present an ideal  
307 vehicle for lifestyle interventions to promote physical activity and reduce sedentary behaviours  
308 amongst university students.<sup>51</sup> Access to resources, health care professionals and research expertise,  
309 within a learning environment, provides an ideal platform for influencing and changing health  
310 behaviours in this population.<sup>51</sup> Given the observed levels of inactivity and sedentary behaviour  
311 within the present study, further research is warranted to further explore the determinants of physical  
312 activity and the role of interventions in favourably changing health behaviours amongst college  
313 students.

314 Over half of students (55.6%) reported their general health as very good/good within the present  
315 study. The results observed within the SASSI survey are significantly lower compared with other  
316 college cohorts, for example, 92.3% of American students reported their health to be excellent, very  
317 good or good in the National College Health Assessment II study<sup>52</sup>. Previous studies amongst the  
318 general population in Ireland have also reported higher ratings; 88% of adults in the SLÁN survey<sup>52</sup>  
319 and 92% of 15-24 year olds in the Healthy Ireland survey.<sup>49</sup> Given the lower ratings observed within  
320 the present study, and the range of variables that may impact upon student health, for example, mood,  
321 social support and sleeping habits,<sup>54</sup> the overall health of college students and the determinants  
322 influencing student health warrants further investigation.

323 Within the SASSI study, respondents who reported meeting the physical activity guidelines were  
324 twice as likely to report feeling healthy as those classed as inactive, with males 22.9% more likely to  
325 report feeling healthy compared with females. Meeting the physical activity guidelines for MVPA

326 has been previously shown to be positively associated with a positive perception of general health  
327 status among American college students,<sup>52</sup> highlighting the association between physical activity and  
328 protective health factors.

329 The average mental health score of students within the SASSI study was 66.7, again representing a  
330 deviation from the general population where mean scores were reported as 86.3 and 81.6 for males  
331 and females aged 15-24 years respectively.<sup>49</sup> A previous study in a smaller sample of Irish students  
332 (n=1,000) recorded a mean score of 72.6.<sup>55</sup> The observed differences in mental health scores amongst  
333 students compared with the general young adult population may be attributable to personal,  
334 developmental and social issues, coupled with the pressures of combining study and paid employment  
335 .<sup>55</sup> Furthermore, the changing landscape of third level education may diminish some of the protective  
336 factors against developing mental health problems during college.<sup>56</sup> Increased student numbers, larger  
337 class sizes and reduced personal support from academic staff may impact upon student experiences in  
338 relation to making friends and developing a sense of belonging.<sup>56</sup>

339 Meeting the physical activity guidelines was also associated with higher mental health scores amongst  
340 respondents within the SASSI survey, with those meeting the guidelines 55% more likely to report  
341 better mental health than those classed as inactive. Males were also 23.3% more likely to report better  
342 mental health compared with females. Depressive symptoms have previously been highlighted as a  
343 risk factor for physical inactivity amongst college students.<sup>45</sup> The associations observed between  
344 physical activity and mental health are consistent with previous research in college students. Students  
345 meeting the recommendations for vigorous physical activity have been shown to be more likely report  
346 positive mood profiles (lower fatigue and higher vigour)<sup>10</sup> and have reduced depressive symptoms<sup>23</sup>  
347 compared with their inactive peers. The gender differences observed within the SASSI survey reflect  
348 the consensus that female students are more likely to report and screen positive for major anxiety  
349 disorders and depression.<sup>19</sup> Given the prevalence of mental health disorders and suicide rates,  
350 particularly amongst young Irish males,<sup>57</sup> third level institutions have a duty to promote mental health  
351 and wellbeing.<sup>19</sup> Hassles, such as 'academic bureaucracy', 'family expectations' and 'financial  
352 security' have been shown to have a negative impact on physical activity levels and may represent

353 avenues that third level institutions can target to reduce distress, and subsequently improve physical  
354 activity behaviours amongst students.<sup>58</sup> Furthermore, the promotion of physical activity, and physical  
355 self-esteem, amongst students may play a role in improving overall quality of life.<sup>59</sup>

356 There is currently a paucity of data examining the relationship between happiness and health related  
357 behaviours in college students. Limited evidence has suggested a possible role for physical activity in  
358 improving levels of happiness.<sup>22</sup> The majority of respondents within SASSI reported high levels of  
359 happiness, with those meeting the physical activity guidelines twice as likely to report feeling happier  
360 than those classed as inactive. A cross-sectional study of European countries highlighted a positive  
361 dose response relationship between happiness and physical activity levels.<sup>22</sup> A survey amongst  
362 Chilean students found a moderate association between daily, regular exercise and happiness.<sup>60</sup>  
363 Promoting the potential role of physical activity on overall wellbeing, including mental health and  
364 happiness, may play a role in engaging students in positive health behaviours.

365 There are a number of limitations that should be taken into consideration when interpreting the  
366 findings of this study. A cross-sectional survey design was undertaken therefore casual relationships  
367 between physical activity and health, mental health and happiness cannot be drawn. Physical activity  
368 was measured using a self-report instrument, yet this was validated in a sub sample of participants.<sup>32</sup>  
369 Health, mental health and happiness were dichotomised based on self-reported perceptions. Future  
370 studies should seek to further explore the reported associations through the use of objective  
371 measurement tools (pedometers, accelerometers) and objective measures of assessing physical activity  
372 related outcomes.

### 373 Conclusions

374 The SASSI study is the first representative, large scale survey of student physical activity and sport  
375 participation across Ireland. This research provides a baseline marker for physical activity levels and  
376 sedentary behaviour amongst university students, which will allow for future monitoring and  
377 evaluation of interventions and policy changes. The observed associations between health enhancing  
378 levels of physical activity and health related outcomes, such as general health, mental health and

379 happiness have been previously understudied in this population and warrant further investigation  
380 within studies employing objective measures and longitudinal design. Active college students enjoy  
381 better health, and are happier than their inactive peers. College represents a key period to engage and  
382 influence numerous health behaviours amongst young adults, and the role that physical activity can  
383 play in improving both physical and mental wellbeing should not be overlooked by third level  
384 institutions as they seek to improve student wellbeing. The findings of the study should help policy-  
385 makers within and outside the third level education sector to determine the most appropriate target  
386 groups for physical activity interventions and determine which interventions might hold the most  
387 promise for increasing activity. In addition both the methodology and the findings provide a useful  
388 comparator for other countries wishing to monitor physical activity in this college-age population.

389

390 **Abbreviations:** BMI, Body Mass Index; CI, Confidence Interval; IPAQ, international physical  
391 activity questionnaire; MVPA, moderate-to-vigorous physical activity; SASSI, Student Activity and  
392 Sports Participation Survey Ireland

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546 Table 1: Demographics

	Overall N (%)	Male N (%)	Female N (%)
<b>Gender</b>			
Female	4112 (50.9)		
Male	3966 (49.1)		
<b>Age range</b>			
18-25	6215 (81.6)	2987 (80.6)	3197 (82.6)
26-35	893 (11.7)	481 (13.0)	407 (10.5)
> 35	506 (6.7)	238 (16.4)	268 (6.9)
<b>BMI</b>			
Underweight	366 (6.1)	152 (5.2)	214 (7.1)
Healthy weight	3904 (65.4)	1874 (63.7)	2010 (66.8)
Overweight	1267 (21.2)	708 (24.1)	554 (18.4)
Obese	437 (7.3)	206 (7.0)	230 (7.6)
<b>Course of study</b>			
Undergraduate	7501 (92.4)	3700 (93.3)	3758 (91.4)
Postgraduate	621 (7.6)	266 (6.7)	353 (8.6)
<b>Mode of study</b>			
Fulltime	7460 (94.1)	3675 (94.8)	3746 (93.3)
Part-time	471 (5.9)	203 (5.2)	268 (6.7)
<b>Field of study</b>			
Humanities and Arts	1168 (14.6)	403 (10.3)	761 (18.9)
Social Sciences, Business and Law	1692 (21.2)	693 (17.7)	996 (24.7)
Education (and teacher training)	387 (4.9)	91 (2.3)	295 (7.3)
Science, Mathematics and Computing	2050 (25.7)	1417 (36.2)	617 (15.3)
Engineering, Manufacturing and Construction	582 (7.3)	446 (11.4)	130 (3.2)
Agriculture and Veterinary	107 (1.3)	54 (1.4)	53 (1.3)
Health and Welfare (including Nursing, health	940 (11.8)	230 (5.9)	704 (17.5)

promotion, physiotherapy)			
Travel Tourism and Leisure	93 (1.2)	27 (0.7)	66 (1.6)
Sports, exercise science related courses	498 (6.2)	356 (9.1)	138 (3.4)
Other	463 (5.8)	193 (4.9)	270 (6.7)
<b>Accommodation</b>			
College/University halls of residence (on campus)	603 (9.6)	238 (7.8)	361 (11.3)
College/University halls of residence (off campus)	455 (7.2)	202 (6.6)	250 (7.8)
Rented privately	2105 (33.4)	1001 (32.7)	1096 (34.2)
Family home	2984 (47.3)	1562 (50.9)	1408 (43.8)
Other	603 (9.6)	63 (2.1)	95 (3.0)
<b>Employment</b>			
Fulltime	426 (6.7)	205 (6.6)	221 (6.8)
Part time	2928 (46.1)	1301 (42.0)	1612 (50.0)
Not working	2998 (47.2)	1592 (51.4)	1394 (43.2)

547

548 Table 2: Health related characteristics

	Overall N (%)	Male N (%)	Female N (%)
<b>General health</b>			
Very good	1001 (15.7)	547 (17.6)	447 (13.8)
Good	2543 (39.9)	1291 (41.5)	1238 (38.4)
Average	2128 (33.4)	971 (31.2)	1152 (35.7)
Poor	556 (8.7)	237 (7.6)	317 (9.8)
Very poor	125 (2.0)	56 (1.8)	69 (2.1)
Don't know	13 (0.2)	8 (0.3)	6 (0.2)
<b>Mental health</b>			
Poor	1441 (22.7)	639 (20.8)	796 (24.6)
Good	4905 (77.3)	2441 (79.2)	2441 (75.4)

<b>Happiness</b>				549
Happy	4076 (64.7)	2028 (66.2)	2027 (63.1)	550
Unhappy	2228 (35.3)	1035 (33.8)	1187 (36.9)	
				551

552 Table 3a Differences in perceived general health (very good, good) due to physical activity level and  
 553 gender

		Model 1		
		Odds ratio	95% CI	p value
Physical activity level	Inactive	1.00		
	Moderately active	1.356	1.104 – 1.666	0.004
	Meeting guidelines	2.233	1.839 – 2.712	0.000
Gender	Female	1.00		
	Male	1.229	1.109 - 1.361	0.000
	Constant	0.633		

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563 Table 3b Differences in perceived mental health due to physical activity level and gender

		Model 1		
		Odds ratio	95% CI	p value
Physical activity level	Inactive	1.00		
	Moderately active	1.231	0.983 – 1.541	0.070
	Meeting guidelines	1.550	1.254 – 1.916	0.000
Gender	Female	1.00		
	Male	1.233	1.092 – 1.392	0.001
	Constant	2.230		

564

565 Table 3c Differences in happiness due to physical activity level and gender

		Model 1		
		Odds ratio	95% CI	p value
Physical activity level	Inactive	1.00		
	Moderately active	1.466	1.195-1.799	<0.001
	Meeting guidelines	2.219	1.828-2.693	<0.001
Gender	Female	1.00		
	Male	1.061	0.954-1.181	0.276
	Constant	0.972		

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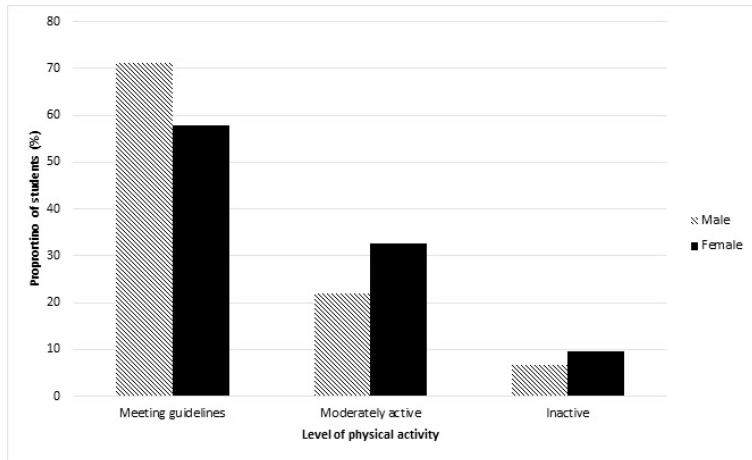
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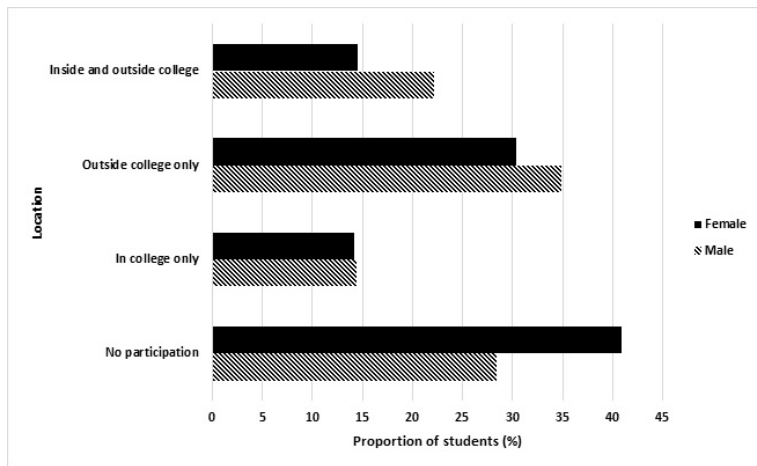
571 **Figures**

572 Figure 1: Proportion of male and female students meeting the physical activity guidelines



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574 Figure 2: Sport and Physical Activity participation by location



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