

1 What Psychosocial Factors Determine the Physical Activity Patterns of University Students?

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4 Abstract

5 **Background:** Although levels of physical activity (PA) have been researched, no information on how
6 university students organise their PA across different life domains is available. The purpose of this
7 study was to explore if, and how, students organise their PA across transport and recreational domains
8 and identify the psychosocial factors related to these patterns.

9 **Methods:** Students from 31 Irish universities completed a supervised online survey measuring
10 participant characteristics, psychosocial factors, and PA. Two-step cluster analysis was used to
11 identify specific PA patterns in students. Binary logistic regressions identified factors associated with
12 cluster membership while controlling for age, sex, household income, and perceived travel time to
13 university.

14 **Results:** Analysis was performed on 6,951 students (50.7% male; 21.51 ± 5.55 years). One Low
15 Active cluster emerged. Four clusters containing a form of PA emerged including Active Commuters,
16 Active in University, Active outside University, and High Active. Increases in motivation and
17 planning improved the likelihood of students being categorised in a cluster containing PA.

18 **Conclusions:** One size does not fit all when it comes to students PA engagement, with five patterns
19 identified. Health professionals are advised to incorporate strategies for increasing students'
20 motivation, action-, and coping planning into future PA promotion efforts.

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25 Introduction

26 The recommendation to increase physical activity (PA) is a key element of health promotion
27 strategies in many countries^{1,2}. Research suggests that late adolescence and early adulthood may be a
28 critical period of transition, for PA engagement¹. Increasing numbers of individuals now spend this
29 period in a university setting, with the number of full-time students increasing from 138,362 in 2007
30 to 181,039 in 2017 in Ireland³. Although university students appear to have the opportunity to be
31 involved in regular PA⁴, university settings are often associated with low levels of PA engagement^{5,6},
32 which are an important risk factor for cardiovascular disease, certain cancers and type-2 diabetes⁷.
33 Additionally, the benefits of regular health enhancing PA on students' mental health^{8,9}, happiness¹⁰,
34 and social interaction¹¹ are also documented. Young adulthood may be a period when people are
35 especially receptive to advice on adopting regular PA¹², with university contexts providing "pivotal
36 settings" of unrealized opportunities to influence the PA of young adults¹³.

37 PA levels of students have been investigated^{1,6,14-17} but no research, to the authors knowledge, has
38 explored how students organise their PA across multiple life domains. PA occurs across at least four
39 life domains: recreational, transport, occupation, and domestic¹⁷⁻¹⁹, with need for a more precise
40 understanding of how students engage in specific PA domains. Research has investigated the
41 relationship between domain-specific PA and health related quality of life in university students¹⁷ and
42 the general population²⁰. Pedišić and colleagues (2014) found that recreational, transport and domestic
43 PA were positively associated with improved health related quality of life, suggesting they have
44 potential for improving students' overall health. Exploring the ways which activities are grouped
45 together across different PA life domains has already been investigated in a general adult
46 population²¹. Rovniak and colleagues (2010) identified three clusters based on adults' (n = 1,689;
47 54.6% male; 44.6 years) PA patterns, which included Low Active, Active Leisure, and Active Job
48 clusters. The clusters identified differed based on socio-economic status, accelerometer measured PA,
49 psychosocial and environmental supports. It was suggested that more extensive transport
50 infrastructure for walking and cycling might be needed to detect an Active Commuter cluster²¹.
51 Recreational, transport and domestic PA have shown the greatest potential for improving students'

52 health related quality of life¹⁷. Additionally, universities tend to offer multiple opportunities for
53 students to partake in recreational (i.e. for enjoyment during discretionary time) and transport PA (i.e.
54 walking and cycling to and from university) through the infrastructures, resources and supports²²,
55 suggesting that these two domains hold the greatest potential for increasing students PA engagement
56 and subsequently health. Identification of how students cluster based on their recreational and
57 transport activities can inform health professionals of how students engage in PA while attending
58 university. Additionally, identification of such patterns in students can have implications for
59 intervention design, as strategies targeting specific PA life domains have been shown to be more
60 effective¹⁹.

61 Once PA patterns are identified, understanding the factors that are associated with these patterns are
62 important⁶, and mapping this information into intervention design is a key step for developing
63 effective evidence-based programs. These can be categorised as internal to the person (i.e. biological
64 and psychosocial) or external to the person (i.e. environmental), with research examining their
65 relationship with overall PA in general and student populations⁶. In the general adult population,
66 attitudes towards exercise, intention to exercise, stress, knowledge of health, action planning, and goal
67 conflicts have been identified as correlates of PA^{23,24}. Psychosocial factors relating to the PA levels in
68 university populations are also reported^{5,6,12,25}, with factors such as self-efficacy, perceived social
69 support, and intrinsic motivation noted as influencing PA levels. However, knowledge of such factors
70 relating to the PA patterns of students across multiple life domains are unknown. It may be useful to
71 examine multiple psychosocial factors at once and note how they relate to the PA patterns of students.
72 For this, a practical tool, such as the determinants of PA questionnaire (DPAQ)²⁵ could be used.
73 Taylor and colleagues (2013) tested the DPAQ in UK university students (N = 465; 30% male; 20.1 ±
74 3.5 years), finding that “high exercisers” showed increased positive emotions and action planning
75 towards PA when compared to “low exercisers”. Knowledge about the benefits of PA and the beliefs
76 about the consequences of PA both scored highly but were found to be similar in both high and low
77 exercisers²⁵. Exploring these relationships will indicate important factors that can be utilised by PA
78 promotion strategies. Thus, the purpose of this study was to explore: i) if and how Irish university

79 students' cluster based on their PA patterns; and ii) what psychosocial factors relate to students' PA
80 patterns while at university.

81 Methods

82 Procedure

83 Participants (N = 8122; 50.9% male; 21.51 ± 5.65 years) were recruited from 31 tertiary level
84 institutes in Ireland using quota based sampling, and considering institution size and field of study.
85 Information on the quota-based sampling procedures can be found in the Student Activity and Sport
86 Study Ireland (SASSI) report²². Participants were recruited through direct contact, as they completed a
87 supervised online questionnaire during class time. This protocol was based on previous research
88 where participation rates in excess of 90% were achieved^{1,26}. The University of Ulster Research
89 Governance approved ethics, with informed consent sought at the beginning of the online
90 questionnaire after a short description of the project.

91 Measures

92 Participant Characteristics

93 Age, sex, socio-economic status, and perceived distance to university were assessed in participants.
94 Socio-economic status was assessed by asking students to 'Please estimate the gross (before tax)
95 annual income of your family household'²⁷, with the seven options ranging from less than 20,000
96 (£/€) to more than 90,000 (£/€). Perceived distance to university was assessed by asking the students
97 'How long does your journey to university usually take?' with participant responses given in hours
98 and minutes.

99 Physical Activity

100 Overall PA was measured using the International Physical Activity Questionnaire – Short Form
101 (IPAQ-SF)²⁸, which has been found to be a valid (77.4% agreement against accelerometry) and
102 reliable (ICC = 0.52 over 9 days) tool for measuring attainment of the PA guidelines (PAGL; ≥ 150
103 mins.MVPA.week) in students²⁹. As mentioned earlier, PA can occur across four life domains but the

104 research team decided to investigate students' behaviours across the recreational and transport
105 domains. This is due to the potential for engaging in recreational and/or transport PA while at
106 university²² and the documented benefits of each for students health related quality of life¹⁷. Transport
107 related PA was measured using a single item measure adapted from the Census of the Irish Population
108 survey³⁰, that asked "How do you usually travel to university (i.e. what is the longest part of your
109 journey)". Responses included six options, including car, bus, train, motorcycle, scooter, bicycle or by
110 foot. Recreational PA was measured using a single item measure adapted from the Higher Education
111 Sport Participation and Satisfaction Survey³¹, which asked students the following; "Thinking about
112 the last 4 weeks, did you do any sporting or recreational PA?" The responses included 1) I have not
113 participated in any sport or PA either within or outside of my university, 2) My participation was only
114 through my university, 3) My participation was only through organisations and facilities not
115 connected to my university, and 4) My participation was both through university and non-university
116 provision.

117 Psychosocial Factors

118 Psychosocial factors of PA were measured using an adapted determinants of PA questionnaire
119 (DPAQ)²⁵. The DPAQ is based on the theoretical domains framework³², which identifies factors and
120 constructs related to PA, and can subsequently signal opportunities for intervention²⁵. The DPAQ was
121 shortened from three (four for action planning) to one statement asked for each of the 11 factors
122 (Suppl. Table 1), with the most appropriate statement selected based on highest loadings shown in
123 confirmatory factor analysis²⁵. These factors include knowledge of the PAGL, perceptions of the
124 environment, motivation, beliefs about capabilities, skills, emotions, social influences, beliefs about
125 consequences, action planning, coping planning and goal conflict regarding PA. Taylor and
126 colleagues (2013) factor analysis was conducted in a UK university staff and students (n = 832;
127 325.8% male; 33.6 ± 11.52), a population similar to the students in Ireland and Northern Ireland.
128 Thus, the results of the factor analysis were seen to apply in some way to the student population of
129 this study. Students selected the most appropriate response using 7-point Likert scales ranging from 1
130 = strongly disagree to 7 = strongly agree.

131 *Statistical Analysis*

132 SPSS Inc., Chicago IL, version 23 was used for all analyses. The responses from a number of
133 measures were analysed or dichotomised before any further statistical analysis. Responses for
134 household income (>£35,000/ €50,000 and <£35,000/ €50,000) and travel activities (active and
135 motorised) were dichotomised. Students distance to university was organised into ten-minute intervals
136 aiding interpretation in further analysis. Student's answers to the IPAQ-SF were analysed as advised
137 by similar research³³, and dichotomised into meeting and not meeting the PAGL³⁴. Negatively phrased
138 questions in the DPAQ were reverse coded so an increase in the score was seen as a positive response
139 to the statement.

140 Descriptive statistics (e.g. means, medians, standard deviations etc.) were calculated for
141 sociodemographic data and for both transport and recreational PA. Pearson's chi-square test for
142 independence was performed to note any significant differences in the transport and recreational
143 physical activities between sexes. A two-step cluster analysis was used as an explanatory tool to
144 identify the PA patterns of university students. This method was designed to handle large data sets
145 and enables the input of categorical variables. The number of clusters was based on the on the log-
146 likelihood distance and Schwarz Bayesian criterion³⁵. The cluster analysis procedures were repeated
147 with five internal random samples (50%) of the total study sample and kappa statistics were used to
148 assess reliability of the cluster solutions³⁶. Participants who did not complete all of the items needed
149 for the cluster analysis were removed from the study. Once a valid and reliable cluster structure had
150 been identified, ANOVA with Bonferroni post hoc (or Welch with Games-Howell post hoc when tests
151 of homogeneity were failed) was used to examine cluster profiles for differences in age and perceived
152 distance to university. Differences between cluster outputs for sex and proportion meeting the PAGL
153 were assessed using chi-square analysis with the adjusted residual (AR) observed³⁷. Binary logistic
154 regressions, with enter method, were used to identify which participant DPAQ item scores predict the
155 cluster membership, whilst controlling for age, sex and household income. Logistic regression allows
156 categorically and continuously scaled variables to predict any categorically scaled criterion³⁸. The
157 binary logistic regression was performed for each cluster output versus the Low Active cluster, with

158 the model containing 11 factor variables and controlling for age, sex and annual household income.
159 The numbers used in the regression analysis were lower due to missing data from a combination of
160 the participant characteristic and DPAQ questions (N = 3,089). Results are presented as Odds Ratios
161 (OR) and 95% Confidence Intervals (CI).

162 Results

163 After data cleaning, the analytical sample comprised of 6,951 participants (50.7 % male; 21.51 ± 5.55
164 years). Participants included for analyses were not significantly different from those excluded for age
165 ($t(7619) = 0.21, p=0.83$) or sex ($X^2(1) = 0.45, p=0.50$). Most participants were undergraduate
166 students (95.2%), studying full-time (95.9%) coming from a household income of less than £35,000
167 or €50,000 (60.9%). Table 1 shows that 66.7% of students reported meeting the PAGL, where
168 significantly more males than females reportedly met the PAGL ($X^2(1) = 121.11, p<0.01$). Most
169 travelled to university using motorised (58.3%) rather than active transport, with no significant
170 difference for sex. Students participated in recreational PA; 1) through their university (15.0%), 2)
171 through organisations and facilities outside their university (31.8%), 3) through organisations and
172 facilities in and outside their university (18.3%), or 4) not at all (32.9%). Participation in recreational
173 related PA was different based on sex ($X^2(3) = 158.21, p<0.01$), with a higher proportion of females
174 reporting no participation and a higher proportion of males reporting participation outside their
175 university or both inside and outside their university.

176 -----Insert Table 1 about here-----

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178 Using PA participation data from the two identified relevant PA life domains -transport and
179 recreational – a two-step cluster analysis was performed to establish if any distinct PA patterns existed
180 for the student population. Results revealed five distinct clusters based on self-reported PA. A very
181 good agreement between the cluster solution derived from the full sample and the five random
182 subsamples was obtained ($kappa = 0.86, p<0.01$). The clusters were given the descriptive titles, based
183 on self-reported PA: Low Active, Active Commuters, Active in University, Active Outside

184 University, and High Active. The next section and Table 2 present the characteristics of each cluster
185 based on the PA domains engaged in, cluster members sex, age, household income, perceived
186 distance to university, proportion meeting the PAGL and the mean scores for each of the DPAQ
187 items. The differences between cluster members for participant characteristics (i.e. sex, age and
188 household income, perceived distance to university), self-reported attainment of the PAGL, and
189 DPAQ item scores are also presented in (Table 2). The results from binary logistic regressions,
190 showing the relationship between the psychosocial factors and clusters, are presented in the following
191 section and Table 3.

192 Cluster Characteristics and Related Psychosocial Factors

193 **Cluster 1: Low Active** – Students in this cluster travelled to university using motorised forms of
194 transport (100%) and did not engage in recreational PA (68.7%). This cluster contained a lower
195 proportion of male students (48.5%), with a mean age of 22.35 ± 6.94 , household incomes of more
196 than €50,000 or £35,000 (34.7%), and living 27.09 ± 14.49 minutes from the university. Over half of
197 students placed in this cluster reported meeting the PAGL (57.1%). The Low Active cluster was used
198 as a reference category for the Chi-square, ANOVA (Table 2) and regression (Table 3) analyses.

199 **Cluster 2: Active Commuters** – This cluster contained students who travelled to university using
200 active forms of transport (100%) and did not engage in recreational PA (100%). When compared to
201 the reference category, this cluster contained younger students (21.06 ± 4.35 , $p < 0.01$) living closer to
202 their university (17.28 ± 10.79 , $p < 0.01$), with fewer achieving the PAGL (51.7%). The regression
203 model was significant ($X^2(15) = 504.19$, $p < 0.01$; $R^2 = 37.1\%$). A one year increase in age (OR=0.95,
204 $p < 0.01$) and a ten minute increase in travel time to university (OR=0.59, $p < 0.01$) decrease the
205 likelihood of being in the Active Commuters cluster when compared to the reference. A one-unit
206 increase in a student's perceived skills (OR=0.89, $p < 0.05$) and beliefs about consequences (OR=0.85,
207 $p < 0.01$) both provide a decreased likelihood of being in this cluster when compared to the Low
208 Active.

209 **Cluster 3: Active in University** – Students in this cluster travelled to university using active transport
 210 (61.1%) and participated in recreational PA through their university (100%). Students in this cluster
 211 were significantly younger (20.43 ± 3.06 , $p < 0.01$), lived closer to the university (19.07 ± 13.46 ,
 212 $p < 0.01$), and were more likely to report attainment of the PAGL (67.2%) when compared to the
 213 reference category. The regression model was significant ($X^2(15) = 267.26$, $p < 0.01$; $R^2 = 20.2\%$). A
 214 one year increase in age (OR=0.92, $p < 0.01$) and a ten minute increase in the time to university
 215 (OR=0.80, $p < 0.01$) reduced the likelihood of being in this cluster compared to the Low Active. A one-
 216 unit increase in a student's motivation (OR=1.13, $p < 0.01$) and action planning (OR=1.22, $p < 0.01$)
 217 both provide an increased likelihood of being in the cluster. A one-unit improvement in a student's
 218 goal conflict (OR=0.91, $p < 0.05$) provides a decreased likelihood of being placed in the cluster as
 219 opposed to Low Active.

220 **Cluster 4: Active outside University** – These students travelled to university using a motorised form
 221 of transport (100%) and participated in recreational PA through organisations external to their
 222 university (100%). A significantly higher proportion of students in this cluster were male (54.8%),
 223 reported a higher household income (41.6%), and reported meeting the PAGL (71.7%). The
 224 regression model was significant ($X^2(15) = 146.86$, $p < 0.01$; $R^2 = 9.3\%$). A one-unit increase in a
 225 student's perception of the environment (OR=1.13, $p < 0.01$), motivation (OR=1.15, $p < 0.01$), action
 226 planning (OR=1.12, $p < 0.01$), and coping planning (OR=1.10, $p < 0.01$) each provide an increased
 227 chance of being in the cluster as opposed to the reference cluster.

228 **Cluster 5: High Active** – This cluster contained students who actively travelled to university (100%)
 229 and participated in recreational PA through both their university and organisations external to their
 230 university (53.6%). Students in this cluster were younger (20.55 ± 3.90 , $p < 0.01$), more likely to be
 231 male (55.7%), reported a higher household income (46.7%), and reported a smaller travel time to
 232 university (16.52 ± 10.82 , $p < 0.01$), when compared to the Low Active cluster. A significantly higher
 233 proportion of these students reported attainment of the PAGL (81.5%). The regression model was
 234 significant ($X^2(15) = 851.05$, $p < 0.01$; $R^2 = 46.5\%$). A one year increase in students' age (OR=0.94,
 235 $p < 0.01$) and a ten minute increase in a travel time to university (OR=0.58, $p < 0.01$) decrease the

236 likelihood of being placed in this cluster as opposed to the Low Active. A one-unit increase in a
237 student's perceptions of their environment (OR=1.11, $p<0.05$), motivation (OR=1.27, $p<0.01$), action
238 planning (OR=1.09, $p<0.05$), and coping planning (OR=1.15, $p<0.01$) each provide an increased
239 chance of being in the High Active cluster.

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241 -----Insert Table 2 about here-----

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243 -----Insert Table 3 about here-----

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245 Discussion

246 The purpose of this study was to explore if and how Irish university students' cluster based on their
247 PA patterns and what psychosocial factors relate to these patterns. An increased understanding of PA
248 engagement can be gained through the examination of different domains¹⁷, while the identification of
249 influential psychosocial factors for promoting PA are important for effective intervention design⁶.

250 Engagement in PA was not the same for all students with five clusters of students containing specific
251 PA patterns identified. Each cluster had somewhat distinct properties including different participant
252 characteristics and behaviours, but some similarities observed for the related psychosocial factors. As
253 research suggests, females, older students and those reporting a lower household income were less
254 likely to be members of certain clusters containing PA^{1,39,40,45}.

255 The Active Commuters cluster had a lower proportion of members meeting the PAGL, which may
256 show a potential problem of the IPAQ-SF for capturing PA through the transport domain⁴¹ even with
257 this found to be the instrument of choice for assessing attainment of the PAGL in students²⁹. A higher
258 proportion of students classified as Active Commuters reported a lower household income
259 (>€50,000/£35,000), which leads to the assumption that students with a low socio-economic status
260 may not see walking to and from university as PA but a necessity since they may not have access to a

261 personal vehicle¹⁵. Additionally, it appears that students lack an understanding of the contribution
262 active transport has for overall PA^{42,43}. Education regarding the role of active commuting for overall
263 PA, in addition to its promotion around university campuses is warranted. The results also show that
264 students in clusters containing transport and/or recreational physical activities in relation to their
265 university perceive their travel time to university as shorter than those in the Low Active cluster do. A
266 10-minute increase in travel time to the university decreased the likelihood of being classified in a
267 cluster containing active commuting and recreational PA at university. Where feasible, universities
268 are advised to provide or inform students of PA opportunities close to their residencies. Additionally,
269 the provision of adequate walk- and cycle paths around university campuses are endorsed to increase
270 the safety for active commuting and to enhance the accessibility of on campus PA facilities. The
271 provision of opportunities close to university housing and adequate transport infrastructure has the
272 potential to increase both transport and recreational PA among students⁴⁴.

273 Certain psychosocial factors were stronger for predicting membership in clusters containing a form of
274 PA. Increased motivation and planning were factors seen to increase the likelihood of students being
275 Active in University, Active Outside University, and High Active. The motives of university students
276 to be physically active are frequently studied with intrinsic reasons such as enjoyment and interest,
277 and extrinsic reasons such as social norms and physical appearance being mentioned^{6,45}. Self-
278 Determination Theory proposes that humans are motivated by their fundamental psychological needs
279 for competence (i.e. ability to interact with the environment), autonomy (i.e. having control over your
280 life) and relatedness (i.e. feeling part of a social group)⁴⁶. University campuses and services external
281 to universities could provide activities for all levels of ability (competence), listen to the students'
282 needs and support their PA choices (autonomy), and overall create a positive environment promoting
283 social inclusion (relatedness), instead of providing PA programs that are only relevant for those who
284 are already active^{47,48}.

285 Action planning is the process of deciding what steps are needed in order to achieve particular goals⁴⁹.
286 It has been noted that university students tend to have unstructured days, making it hard for them to
287 plan their PA⁶, but each student is given a class timetable when beginning each semester that could be

288 used as an aid for such planning. Coping planning, which was seen to enhance the likelihood of being
289 in the Active outside University and High Active clusters, should be used in addition to action
290 planning to create strategies that increase PA engagement in students. Coping planning is a barrier-
291 focussed, self-regulation strategy where a person anticipates the risk situations and develops suitable
292 coping responses⁴⁹. Strategies could include prompting students to recognise times in the semester
293 when engagement in PA may be difficult (e.g. examination periods) and identifying other ways to stay
294 physically active during these times. Research has noted that forming action plans in addition to
295 coping plans increases the likelihood of longer-term behaviour change⁴⁹.

296 Curiously, increased beliefs about the consequences of not being physically active and perceived skill
297 levels were factors found to reduce the likelihood of being an Active Commuter. Again, this questions
298 their knowledge of the benefits and contribution of active commuting for overall PA and health^{42,43,50}
299 and suggests a need for awareness raising in such students. Finally, these findings suggest that
300 knowledge of the recommended PAGL, beliefs about capabilities, emotions towards PA, and social
301 influences for PA had no effect on cluster membership. Taylor and colleagues (2013) found
302 knowledge of PA to have no effect on students' exercise levels, which may suggest that possessing
303 such knowledge alone may be insufficient to induce PA participation. Alternatively, knowledge of the
304 PAGL was the lowest scored item of the DPAQ, warranting the promotion of these recommendations
305 due to the positive association between knowledge and increased PA^{51,52}.

306 This study addresses an important topic identifying the patterns of PA in a large sample of students
307 from the whole island of Ireland, which could be considered its greatest strength. A second strength
308 were the clustering patterns, which have emerged from the data-driven approach and used empirical
309 measures to minimise subjectivity in deciding the number of clusters. A number of limitations also
310 need to be noted in the present study, with the most evident being the student survey, which was self-
311 reported and thus liable to social desirability and recall bias³⁹. The DPAQ was adapted from its
312 original, with one question selected for each of the eleven areas, as opposed to multiple. This was
313 done for practical purposes, with the process for selecting the most appropriate questions for each
314 section found in the methods section. Another limitation of the DPAQ is that we cannot confirm

315 whether students were motivated to engage in PA for external or internal reasons. Recreational and
316 transport PA were measured using single item tools which allow for quick and easy measurement, but
317 do not allow us to investigate the frequency or intensity of the activities. In addition, the unknown
318 psychometric properties of the shortened and adapted measures used should be acknowledged,
319 suggesting a need to test the validity and reliability of them in future research. Finally, the use of
320 another PA domain (e.g. occupational PA) in the analysis may have led to different cluster outputs.
321 The use of the occupational and domestic life domains would also help understand how the Low
322 Active students are engaging in PA, if at all, and should be considered in the future.

323 Conclusion

324 Research suggests that PA can be better understood through its examination across multiple life
325 domains¹⁷ and these results provide this deepened understanding of students PA engagement.
326 Identification of these patterns can help target students not engaging in any PA (i.e. Low Active),
327 while creating the opportunity for research to investigate their relationship with psychosocial factors,
328 the university environment, and health outcomes. Psychosocial factors that have a positive influence
329 on PA engagement have been identified in this study and need to be mapped into effective
330 intervention design helping create active student populations. Health professionals are advised to
331 incorporate strategies for increasing students' motivation, action-, and coping planning into their
332 future PA promotion efforts.

333 Acknowledgements and Funding

334 The authors would like to thank all researchers and participants involved in SASSI. This study was
335 funded by Student Sport Ireland.

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487 Table 1. Percentage of students meeting the physical activity guidelines and participating in the
 488 recreational and transport physical activity.

	Total (n= 6951)	Male (n= 3512)	Female (n= 3409)	X ² (df)
PAGL				
Meeting	66.7	55.5	44.5	121.11(1)**
Transport related PA				
Active Transport	41.7	49.8	50.2	1.66(1)
Recreational related PA				
No Participation	32.9	41.5	58.5 ^a	158.21(3)**
Inside University	15.0	48.5	51.5	
Outside University	31.8	54.5 ^a	45.5	
Both Inside & Outside	18.3	61.6 ^a	38.4	

489 X²: *= p<0.05, **= p<0.01; the total number is higher due to missing data in the sex question (n= 30);

490 Adjusted Residuals: ^a= higher proportion than expected.

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493 Table 2. Cluster characteristics and differences based on participant characteristics, attainment of the physical activity guidelines, and DPAQ item scores.

	Low Active	Active Commuters	Active in University	Active Outside University	High Active
Cluster Characteristics	N = 2090	N = 850	N = 1046	N = 1554	N = 1411
Recreational PA	None (68.7%)	None (100%)	In University only (100%)	Outside University only (100%)	In and outside University (53.6%)
Transport PA	Motorised (100%)	Active (100%)	Active (61.1%)	Motorised (100%)	Active (100%)
Participant Characteristics					
Sex (% Male)	48.5	43.4	48.5	54.8 ^a	55.7 ^a
Age (Mean ± SD)	22.35 ± 6.94	21.06 ± 4.35**	20.43 ± 3.06**	22.25 ± 6.29	20.55 ± 3.90**
Household Income (%> €50,000/£35,000)	34.7	30.9	41.0 ^a	41.6 ^a	46.7 ^a
Perceived Distance (Mean minutes ± SD)	27.09 ± 14.49	17.28 ± 10.79**	19.07 ± 13.46**	27.43 ± 14.16	16.52 ± 10.82**
Physical Activity					
% Meeting PAGL	57.1	51.7 ^b	67.2 ^a	71.7 ^a	81.5 ^a
DPAQ Item Scores (Mean ± SD)					
Knowledge	3.15 ± 2.02	2.98 ± 2.01	3.17 ± 1.99	3.31 ± 2.02	3.37 ± 2.02*
Environment	5.94 ± 1.44	6.04 ± 1.34	6.16 ± 1.31**	6.23 ± 1.18**	6.41 ± 1.16**
Motivation	4.55 ± 1.80	3.95 ± 1.72**	4.95 ± 1.55**	5.20 ± 1.53**	5.51 ± 1.40**
Beliefs about capabilities	4.58 ± 1.97	3.77 ± 1.90**	4.74 ± 1.76	5.14 ± 1.80**	5.26 ± 1.73**
Skills	4.79 ± 1.87	4.02 ± 1.79**	4.95 ± 1.63	5.34 ± 1.65**	5.53 ± 1.57**
Emotions	5.19 ± 1.84	4.61 ± 1.89**	5.24 ± 1.72	5.67 ± 1.57**	5.75 ± 1.54**
Social Influences	4.60 ± 1.95	4.25 ± 1.83**	4.91 ± 1.76**	5.07 ± 1.87**	5.26 ± 1.79**
Beliefs about consequences	5.93 ± 1.34	5.73 ± 1.37**	6.05 ± 1.21	6.11 ± 1.26**	6.30 ± 1.03**
Action Planning	4.75 ± 1.75	4.49 ± 1.72**	5.28 ± 1.54**	5.26 ± 1.60**	5.52 ± 1.48**
Coping Planning	3.55 ± 1.79	3.01 ± 1.54**	3.77 ± 1.58**	4.18 ± 1.72**	4.45 ± 1.66**
Goal Conflict	4.06 ± 1.86	3.61 ± 1.67**	4.16 ± 1.63	4.51 ± 1.67**	4.90 ± 1.56**

494 Reference category = Low Active Cluster; ANOVA (Bonferroni/ Games-Howell) * = p<0.05; ** = p<0.01; Chi square (Adjusted Residuals) ^a higher
495 proportion than reference category, ^b lower proportion than the reference category.

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499 Table 3. Psychosocial factors predicting cluster membership when compared to the Low Active students.

Likelihood of being in each cluster for every unit increase of each DPAQ item score									
	Active Commuters		Active in University		Active Outside University		High Active		
N	475		524		845		803		
X ² (df)	504.19 (15)**		267.26 (15)**		146.86 (15)**		851.05 (150)**		
Nagelkerke's R ²	37.1		20.2		9.3		46.5		
	OR	95% C.I.	OR	95% C.I.	OR	95% C.I.	OR	95% C.I.	
Participant Characteristics									
Age	0.95**	0.92 - 0.97	0.92**	0.90 - 0.95	1.00	0.99 - 1.02	0.94**	0.92 - 0.96	
Sex (female)	0.89	0.68 - 1.15	1.02	0.81 - 1.29	0.96	0.79 - 1.16	0.83	0.66 - 1.06	
Income (>50,000 or 35,000)	0.78	0.59 - 1.02	0.95	0.76 - 1.20	1.15	0.95 - 1.40	1.25	1.00 - 1.57	
Distance (+ 10 minutes)	0.59**	0.54 - 0.63	0.80**	0.76 - 0.83	1.01	0.98 - 1.04	0.58**	0.54 - 0.61	
DPAQ Item Scores									
Knowledge	0.98	0.92 - 1.04	1.00	0.95 - 1.06	1.00	0.96 - 1.05	1.01	0.96 - 1.07	
Environment	1.08	0.98 - 1.19	1.08	0.99 - 1.19	1.13**	1.05-1.21	1.11*	1.00 - 1.22	
Motivation	0.96	0.88 - 1.04	1.13**	1.03 - 1.23	1.15**	1.07-1.23	1.27**	1.16 - 1.38	
Beliefs about capabilities	0.92	0.83 - 1.02	1.05	0.95 - 1.15	0.98	0.91 - 1.05	1.01	0.92 - 1.11	
Skills	0.89*	0.80 - 0.99	1.01	0.91 - 1.11	1.06	0.98 - 1.13	1.07	0.97 - 1.18	
Emotions	1.00	0.92 - 1.09	0.94	0.86 - 1.02	1.05	0.98 - 1.13	0.97	0.89 - 1.06	
Social Influences	1.01	0.94 - 1.09	1.04	0.97 - 1.11	1.02	0.97 - 1.08	1.00	0.94 - 1.07	
Beliefs about consequences	0.85**	0.76 - 0.95	0.91	0.82 - 1.02	0.97	0.89 - 1.05	1.02	0.90 - 1.15	
Action Planning	0.99	0.91 - 1.07	1.22**	1.12 - 1.33	1.12**	1.05 - 1.19	1.09*	1.00 - 1.18	
Coping Planning	0.93	0.84 - 1.02	1.00	0.92 - 1.09	1.10**	1.03 - 1.18	1.15**	1.05 - 1.25	
Goal Conflict	0.98	0.90 - 1.07	0.91*	0.84 - 0.99	0.95	0.88 - 1.01	1.00	0.91 - 1.08	

500 Binary logistic Regression: Reference category = Low Active Cluster (N = 1215); * = p<0.05, ** = p<0.01, ^a = included in the final step but non-significant;
 501 NS = not significant; OR = Odds Ratio; 95% C.I. = 95% Confidence Interval.

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