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How does the university environment relate to student's physical activity patterns in Ireland

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Abstract

Background

Identifying factors related to physical activity in university students can aid the development of health promotion interventions, but there is limited research regarding the influence of university environments. This study examined the relationship between level of provision for university environments that aim to promote physical activity and self-reported physical activity patterns of students.

Methods

An environmental audit tool was completed by universities ($n = 28$) on the island of Ireland to acquire information about physical activity opportunities, resources and supports offered. Students ($N = 6,951$; 50.7 % male; 21.51 ± 5.55 years) completed an online survey, providing responses about their active transport and recreational physical activity behaviours. Binary logistic regressions were used to examine the associations between environmental factors that support physical activity and clustered physical activity patterns, while controlling for gender, age and university size.

Results

Universities with a high provision for organisational structures and internal partnerships, indoor facilities, and sport clubs increase the odds of their students having more active physical activity patterns. Increased provision of investment and personnel were seen to have a mixed relationship with students physical activity engagement, highlighting the need to understand where resources are needed and not just increase them.

Conclusions

It is important for universities to have adequate organisational structures with internal partnerships to understand how resources can be maximised to support physical activity engagement across the whole student population. University campuses hold the potential for increasing student engagement in physical activity and these findings can help inform campus-wide initiatives that foster active student populations for improving overall long term health.

Introduction

Research demonstrates an association between regular physical activity (PA) and a reduced risk for more than 25 chronic medical conditions, and furthermore premature mortality^{1,2}. Identification of major life transitions can be important as they often represent critical or teachable moments to intervene and promote healthy behavioural habits such as PA engagement⁴. A transitional period for many people is the transition from adolescence to adulthood through a university setting, with over 18 million people enrolled in universities around the European Union in 2020⁵. This transition sees young adults pass from the well-controlled high school environment to a more independent living that is often accompanied by unhealthy behaviour changes such as decreasing PA^{6,7,8}. Large cross-sectional studies, prior to the COVID-19 pandemic, have shown that PA levels of students vary from 27% to 89% in males and 14% to 85% in females^{9,10}, with a decline in PA engagement as students advance through their university years¹¹. A systematic review by López-Valenciano and colleagues (2021) also found that total PA levels in university students had reduced during the COVID-19 pandemic confinements. However, they also found that those who met the recommended guidelines before any COVID-19 restrictions were more likely to also meet recommendations during restrictions, highlighting the importance of enabling PA engagement during tertiary education, as it can lead to long-term behaviour change¹². Research notes the importance of studying any observable PA patterns within clusters of population samples to gain a deepened understanding¹³. A previous study identified five PA patterns across the transport and recreational domains in 6,951 university students on the island of Ireland¹⁴. The study highlighted that health professionals and third level institutions need to incorporate strategies that influence students' motivation, action planning and coping planning for PA engagement.

A key principle of intervention design is to identify and understand factors that relate to behavioural patterns, aiding with the development of interventions that influence behaviour^{15,16}. Factors seen to influence PA in university students include personal (e.g. biological and psychological), behavioural (e.g. past PA, dietary habits etc.) and environmental (e.g. social, physical, natural) with personal factors being extensively studied in the research^{15,17}. Environmental factors that can support PA are less studied, but it is

known that an individual's surroundings can influence their PA behaviours^{15,7,17}. Choi and colleagues (2017) identified nineteen studies investigating the environmental factors related to PA in general adult populations. Factors relating to PA included accessibility to facilities, presence of sidewalks, aesthetics and neighbourhood safety, but most factors were found to be inconclusive¹⁸. Furthermore, a recent review found that environmental context and resources were the most frequently referenced factors when assessing key influences on university student's PA¹⁹. The review highlighted the need for easily accessible, safe and enjoyable, and weather appropriate facilities and infrastructure to help support PA engagement in university students. This evidence highlights the influence of the university environment on student PA, however further research is needed to understand how the provision of university environments to support PA relate to PA behaviours in students.

The university setting provides an opportunity to target a large proportion of young adults and influence their PA behaviours through the institutional, community, and public policy levels²⁰. Keating and colleagues (2005) stated that universities are one of the few settings where environmental strategies could be effective due to the adaptability of university policies or the remodelling of campuses to promote PA. It is becoming increasingly important to design and create university campuses that promote healthy behaviours, especially since students spend a considerable amount of time in educational environments that promote sedentary behaviours (e.g. sitting in lectures, completing written assignments)²¹. By doing so, we may encourage students to develop healthy lifestyles that persist into later life and determine long-term health outcomes⁴. This is expressed through strategies such as the UK Healthy Universities Framework, which encourages universities to "create a learning environment and organisational culture that improves health, well-being, and sustainability in its community"²². However, a recent study using a photovoice method across two universities in Germany found that they were not exploiting their potential of fostering daily PA within students on campus²³. The influence of the university campus on students' health behaviours, especially PA behaviours is still unclear, with little research showing the associations between facilities, opportunities, supports and resources provided by universities and students' PA engagement¹⁷. Research notes that most studies assess an individual's perception of their environment as

opposed to the environment itself¹⁵. Thus, the purpose of this study was to examine the relationship between the provision of university environments to support PA with the self-reported PA patterns of university students.

Methods

Data was gathered in 2014 from thirty-three universities as part of the Student Activity and Sport Study Ireland (SASSI)²⁴. Voluntary institutional champions (IC) were assigned in each university, who recruited respondents and assisted with the administration and completion of a university environmental audit tool (UEAT) and student survey (SS). Each university was given an identifier code that provided both anonymity and linked the responses from the UEAT and the SS allowing examination between the university environments provided and the students' self-reported PA behaviours. Efforts were made to include different sized universities on the island of Ireland in this study to allow a wider assessment of the current environments offered. University size was based on the distribution of the 2013/14 fulltime under- and postgraduate enrolment figures^{25,26}. The following university size classification was agreed by the research team: i) Large: > 11,000 students; ii) Medium: 4,000 - 10,999 students; iii) Small: < 3,999 students. A full overview of the methods used within SASSI can be found in a previous publication²⁷.

University Environmental Audit Tool (UEAT)

Information about the university provision for PA was acquired using the UEAT, a tool developed as part of SASSI²⁴. UEAT was administered to the IC in each university who then acquired information from relevant university personnel. These people included the ICs and the following staff or equivalent in each university: Director of Sport; Sport/Clubs and Societies Officer; Health/PA Promotion Officer. The number of participants involved in the completion of the UEAT varied across universities, due to different types of roles and personnel's available time in each university. To ensure ease of completion, a 'save as you go' function was applied to the UEAT allowing respondents to edit their answers and save their progress. The UEAT was comprehensive and included a series of open and closed questions that gathered information regarding the following: i) organisational structures of PA; ii) personnel; iii) facilities provided; iv) funding/investment for PA; v) student sport and PA participation figures; vi) high performance

programmes; and vii) institutional ethos and prioritisation. A full version of the UEAT can be seen in Supplementary File 1. The UEAT was designed so that university provision for each key construct could be usefully scored and analysed. Eleven key performance indicators (KPIs) were calculated (Supplementary File 2) from the UEAT responses and represent the environment and provision made by universities to support student participation in PA. A university score for total provision and for provision relative to 100 students was calculated for each KPI listed below. The development of these scores facilitated the analysis of total and relative provision for each KPI across small, medium, and large institutions. The different categories of provision were determined by calculating a university rank (from lowest = 1 to highest = 33) for both the total provision score and the total score relative to 100 students. These two ranking values were then summed and ranked to create a composite rank for each university. Based on this composite rank, institutions were assigned equally to either a high, medium or low provision category for each KPI (i.e. ranks 1-11 = high; ranks 12-22 = medium; and ranks 23-33 = low). Of these eleven KPIs, eight were selected for this study based on their appropriateness. These included organisational structures, staffing, indoor facilities, outdoor facilities, current investment from the past 5 years, number of sport clubs, and perceived quality of sport and PA provision. Participation in sport clubs, and participation in exercise and fitness opportunities were removed from the analysis as they were seen as outcomes of the university environment and provision, while a lower number of universities responded to the capital investment for facilities question so it was not used in this analysis (n = 24/28 completed for indoor facilities; n = 20/28 completed for outdoor facilities). This question asked participants to report total capital spending for indoor and outdoor facilities related to PA engagement since 1995. This may have been difficult to recall and how this is collected is something that needs to be considered in future research.

Student survey (SS)

Student data was collected through a cross-sectional SS asking questions about participant demographics and PA behaviours. University students (n = 8,122; 50.9% male; 21.51 ± 5.65 years) from 31 tertiary level institutes in Ireland completed the SS. Quota based sampling was used to select students based on year and field of study, which gathered a sample that reflected the national enrolment figures^{25,26}. Information

on the quota-based sampling procedures is available in the SASSI report²⁴. The ICs of each university recruited students through direct contact and supervised the completion of the online survey during class time.

The SS assessed the sex, age and PA behaviour of students across the transport and recreational domains. Transport related PA was measured using an adapted single item measure asking students “how do you usually travel to university (what is the longest part of your journey)?”²⁸. Responses included six options that were dichotomised into motorised/public transport (i.e. car, bus, train, motorcycle or scooter) or active (i.e. by foot or bicycle) transport. Recreational PA was measured using an adapted single item measure asking students “thinking about the last 4 weeks, did you do any sporting or recreational PA?” Responses included i) I have not participated in any sport or PA either within or outside of my university; ii) my participation was only through my university iii) my participation was only through organisations and facilities not connected to my university; and iv) my participation was both through university and non-university provision²⁹.

Statistical Analysis

SPSS Inc., Chicago IL, version 23 was used for all analyses. Descriptive statistics (e.g. means, standard deviations, proportions etc.) were calculated for demographic data and for each KPI. A two-step cluster analysis was used as an exploratory tool to identify the PA behavioural patterns across the transport and recreational domains for this sample. The number of clusters was based on the log-likelihood distance and Schwarz-Bayesian criterion³⁰. The full procedure for the cluster analysis is available in a previous study¹⁴. Participants who did not complete all items needed for the cluster analysis were removed from the study. Binary logistic regressions were used to assess how the KPI of the university environment relate to student PA behavioural patterns across the transport and recreational domains. Logistic regression was chosen as the statistical approach as it allows categorically and continuously scaled variables to predict any categorically scaled criterion³¹. The ‘Low Active’ cluster and the ‘Low’ classification for each KPI were used as the reference category in the analysis. The analysis controlled for age, sex and university size. These three variables were related to cluster placement in a previous publication¹⁴.

Results

Of the thirty-three universities sent the UEAT, 28 provided adequate responses for this study. These universities were classified as small ($n = 12$), medium ($n = 10$) or large ($n = 6$) based on enrolment figures^{17,18}. After data cleaning, the analytical sample for the SS comprised of 6,951 participants (50.7 % male; 21.51 ± 5.55 years). Participants included for analyses were not significantly different from those excluded for age ($t(7620) = 0.395$, $p=0.78$) or sex ($\chi^2(1) = 0.45$, $p=0.50$). Most participants were undergraduate students (95.2%) and studying full-time (95.9%), with students attending small (22.0%), medium (26.1%) or large (51.9%) sized universities. Table 1 provides a breakdown of the universities identified as having a low, moderate or high provision for each of the KPIs observed. Table 2 shows the proportion of students attending universities based on the level of provision for each KPI. Most students attended a university that indicated a high provision for staffing (38.1%), indoor (39.3%) and outdoor facilities (40.0%), current investment (49.3%), number of sports clubs (41.1%), and had high perceived quality of sport provision (49.9%). A majority of students also attended universities that had a moderate provision for organisational structures (51.4%) and had moderate perceived quality of PA provision (43.3%).

Table 1. Proportion of universities providing a low, moderate or high provision of each key performance indicator.

Key Performance Indicator	N	Low (N; %)	Moderate (N; %)	High (N; %)
Organisational Structure	28	8 (28.6)	11 (39.3)	9 (32.1)
Staffing	28	9 (32.1)	10 (35.7)	9 (32.1)
Inside Facilities	28	8 (28.6)	9 (32.1)	11 (39.3)
Outside Facilities	28	8 (28.6)	10 (35.7)	10 (35.7)
Current Investment	27*	7 (25.9)	11 (40.7)	9 (33.3)
Number of Sports Clubs	28	9 (32.1)	10 (35.7)	9 (32.1)
Perceived quality of Sports Provision	28	9 (32.1)	8 (28.6)	11 (39.3)
Perceived quality of PA Provision	28	9 (32.1)	9 (32.1)	10 (35.7)

* = numbers are reduced due to missing data.

Table 2. Proportion of students attending universities based on the provision of each key performance indicator.

Key Performance Indicator	N	Low (%)	Moderate (%)	High (%)
Organisational Structure	6834	21.3	51.4	27.3
Staffing	6834	25.0	36.9	38.1
Inside Facilities	6834	22.7	38.0	39.3
Outside Facilities	6834	20.1	39.9	40.0
Current Investment	6798*	11.8	38.9	49.3
No. of Sports Clubs	6834	18.1	40.8	41.1
Perceived quality of Sports Provision	6834	14.5	35.6	49.9
Perceived quality of PA Provision	6834	15.6	43.3	41.1

* = numbers are reduced due to missing data.

Using self-reported PA participation from two PA life domains - transport and recreational- the two-step cluster analysis identified five distinct clusters of students based on their PA patterns¹⁴. The clusters were given descriptive titles, based on their key characteristics, with Table 3 providing an overview of each cluster. The relationship between each university KPI and each cluster group can be seen below, with the full results including the confidence intervals shown in Table 4.

Table 3. Cluster characteristics based on recreational and transport physical activity behaviour.

Cluster Name	Type of Physical Activity	
	Recreational	Transport
Low Active	None (68.7%)	Motorised/Public Transport (100%)
Active Commuters	None (100%)	Active (100%)
Active in University	In university only (100%)	Active (61.1%)
Active outside University	Outside university only (100%)	Motorised/Public Transport (100%)
High Active	In and outside university (100%)	Active (100%)

Active Commuters: The regression model was significant ($X^2 = (20) 318.46$, $p < 0.01$; $R^2 = 16.0\%$). Moderate provision of organisational structures ($\text{Exp}(B) = 8.336$) and a moderate perception of the quality of sport provision ($\text{Exp}(B) = 6.291$) increased the likelihood of being in the cluster as opposed to the Low Active cluster. High provision of organisational structures ($\text{Exp}(B) = 12.800$), indoor facilities ($\text{Exp}(B) = 3.220$), sports clubs ($\text{Exp}(B) = 1.815$), and a high perception of the quality of sport provision ($\text{Exp}(B) = 4.899$) also increased the likelihood of being an active commuter. Moderate provision of outdoor facilities ($\text{Exp}(B) = 0.548$) and

high provision of staffing (Exp(B)=0.492) and current investment (Exp(B)=0.169) decreased the likelihood of being in this cluster.

Active in University: The regression model was significant ($X^2 = (20) 277.97$, $p < 0.01$; $R^2 = 12.8\%$). Moderate provision of organisational structures (Exp(B)=5.182), indoor facilities (Exp(B)=2.857), and a moderate perception of the quality of sport provision (Exp(B)=5.478) increased the likelihood of being 'Active in University' as opposed to the Low Active cluster. High provision of organisational structures (Exp(B)=6.970), indoor facilities (Exp(B)=6.244), sport clubs (Exp(B)=1.878), and a high perception of the quality of sport provision (Exp(B)= 2.867) increased the likelihood of being active in university. Moderate and high provision of outdoor facilities (Exp(B)=0.376; Exp(B)=0.306) and high provision of current investment (Exp(B)=0.350) decreased the likelihood of being in this cluster.

Active outside University: The regression model was significant ($X^2 = (20) 57.97$, $p < 0.01$; $R^2 = 2.3\%$). Moderate provision of sport clubs (Exp(B)=0.548) and a moderate or high perception of the quality of PA provision (Exp(B)=0.380; Exp(B)=0.268) decreased the likelihood of being 'Active outside University' as opposed to being 'Low Active'.

High Active: The regression model was significant ($X^2 = (20) 497.46$, $p < 0.01$; $R^2 = 19.5\%$). Moderate provision of organisational structures (Exp(B)=15.418), indoor facilities (Exp(B)=2.104), current investment (Exp(B)=3.110), and moderate perceptions of the quality of sport provision (Exp(B)=21.185) each increased the likelihood of being in the 'High Active' cluster. High provision of organisational structures (Exp(B)=25.833), indoor facilities (Exp(B)=9.096), sport clubs (Exp(B)=1.658), and high perceptions of the quality of sport provision (Exp(B)=8.901) also increased the likelihood of being in this cluster. High provision of staffing (Exp(B)=0.406), outdoor facilities (Exp(B)=0.338), and current investment (Exp(B)=0.344) decreased the likelihood of being in the high active cluster. Both moderate and high perceptions of the quality of PA provision (Exp(B)=0.122; Exp(B)=0.221) also decreased the likelihood of being in this cluster.

Table 4. Binary logistic regressions showing factors predicting cluster membership when compared to the reference category in students.

		Active Commuter		Active in Uni		Active outside Uni		High Active	
N		781		968		1421		1294	
X ² (df)		318.46 (20)**		277.971 (20)**		57.970 (20)**		497.462 (20)**	
Nagelkerke's R ²		0.160		0.128		0.023		0.195	
Demographics		Exp(B)	CI	Exp(B)	CI	Exp(B)	CI	Exp(B)	CI
Gender	Male	.846	0.704-1.016	1.061	0.898-1.253	1.205*	1.046-1.389	1.434**	1.226-1.677
Age	Increase	.972**	0.955-0.989	0.936**	0.917-0.955	1,004	0.993-1.015	0.947**	0.931-0.964
University Size	Moderate	1.146	0.705-1.863	1.351	0.880-2.073	1.601*	1.110-2.309	1.168	0.800-1.705
	Large	4.093**	2.361-7.093	2.111**	1.335-3.338	1.764	1.182-2.632	2.599**	1.718-3.933
KPI		Exp(B)	CI	Exp(B)	CI	Exp(B)	CI	Exp(B)	CI
Organisational Structure	Moderate	8.336**	4.377-15.876	5.182**	3.004-8.937	1.480	0.923-2.370	15.418**	9.077-26.191
	High	12.800**	6.621-24.747	6.970**	3.944-12.315	1.577	0.998-2.493	25.833**	15.052-44.337
Staffing	Moderate	1.227	0.757-1.990	1.143	0.752-1.737	0.972	0.681-1.387	1.092	0.733-1.628
	High	0.492**	0.313-0.715	0.824	0.566-1.198	0.803	0.592-1.090	0.406**	0.286-0.576
Facilities (In)	Moderate	1.567	0.877-2.801	2.857**	1.671-4.886	1.205	0.796-1.823	2.104**	1.318-3.358
	High	3.220**	1.795-5.776	6.244**	3.728-10.458	1.345	0.877-2.064	9.096**	5.748-14.394
Facilities (Out)	Moderate	0.548**	0.358-0.838	0.376**	0.256-0.551	1.275	0.925-1.757	0.676	0.472-0.968
	High	0.335	0.147-0.766	0.306**	0.149-0.632	0.780	0.441-1.378	0.338**	0.173-0.662
Current Investment	Moderate	1.401	0.801-2.452	1.546	0.952-2.512	1.064	0.736-1.539	3.110**	1.946-4.971
	High	0.169**	0.085-0.335	0.350**	0.193-0.636	0.905	0.548-1.492	0.344**	0.195-0.605
Number of Sport Clubs	Moderate	0.818	0.461-1.451	1.402	0.855-2.299	0.548**	0.350-0.857	1.016	0.644-1.605
	High	1.815**	1.186-2.776	1.878**	1.292-2.730	0.784	0.581-1.058	1.658**	1.152-2.388
PQ of Sport Provision	Moderate	6.291**	2.644-14.969	5.478**	2.615-11.477	2.112	1.170-3.811	21.185**	10.084-44.508
	High	4.899**	2.371-10.123	2.867**	1.506-5.458	1.841	1.120-3.027	8.901**	4.708-16.825
PQ of PA Provision	Moderate	0.320	0.127-0.805	0.415	0.188-0.917	0.380**	0.209-0.694	0.122**	0.052-0.241
	High	0.568	0.191-1.695	0.826	0.321-2.124	0.268**	0.131-0.550	0.221**	0.090-0.540

Reference Category = Not Active (n = 1886); Each KPI level is compared against the Low category; * = p<0.05; ** = p<0.01; PQ = perceived quality; CI = confidence interval.

1 Discussion

2 To the authors knowledge this study is the first to investigate the relationship between the university
3 environment for supporting PA engagement and students' PA patterns in an Irish context. Two-step cluster
4 analysis in a previous study¹⁴ revealed that this sample of Irish university students' cluster into groups of
5 specific PA patterns, described as 'Low Active', 'Active Commuters', 'Active in University', 'Active outside
6 University', and 'High Active'. It is clear from the current results that a change in the environment and
7 provision for PA opportunities by universities can relate to a student's PA pattern. Attending a large
8 university versus a small university sees an increased likelihood for students' to be 'Active Commuters',
9 'Active in University', or 'High Active' as opposed to 'Low Active'. Leslie and colleagues (1998) examined
10 Australian universities finding that small campuses (<3,000 students) offered fewer on-campus facilities
11 when compared to larger campuses, which may create a reduction in opportunities for students to engage
12 in PA while at university. Additionally, larger universities may be located in more populated areas with
13 improved transport structures, positively influencing students' active commuting to and from university.
14 However, evidence does highlight a potential relationship between reduced active travel behaviours due to
15 campus size³³ or general PA engagement due to facilities and other infrastructure to support PA being
16 located too far from the campus or student residences¹⁹. Each KPI measured had a unique relationship
17 with a students' likelihood of being placed in one of the cluster groups containing a form of PA as opposed
18 to being 'Low Active', with an exception to those seen as 'Active outside University'. The university KPIs had
19 little associations with the likelihood of a student being Active outside University, suggesting that those
20 active outside their university are influenced by environmental factors that support PA and are external to
21 the university campus. This might include factors such as satisfaction with neighbourhood services and ease
22 of walking to public transportation stops, which have both been found in previous research³⁴.

23 Moderate and high provision of organisational structures and internal partnerships for PA within the
24 university increased the likelihood of students being an 'Active Commuter', 'Active in University', or 'High
25 Active'. The findings show the importance of having organisational structures and internal partnerships in
26 place for the facilitation and support of PA opportunities for students' PA engagement while at university.

1 Within a community, Martin and Vehige (2006) suggest that there is a need for organisational structures
2 that contribute to the growth and sustainability of PA and health through the encouragement and support
3 of collaborative partnerships. Such a concept should be projected and encouraged within the university
4 setting, whereby the organisational structures are encouraged to collaborate, allowing for the combination
5 and capitalisation of strengths from each partner organisation involved. Moderate levels of current
6 investment increased the likelihood of students being 'High Active', while high levels of current investment
7 decreased the likelihood of students being 'Active Commuters', 'Active in University', or 'High Active'.
8 Universities are allocating large financial resources for the provision of facilities, supports and opportunities
9 for PA engagement³⁶ but the findings suggest that more investment does not necessarily mean increased
10 PA engagement. The nature of the current investment for PA was not asked in this study and that could be
11 seen as a limitation. Research should investigate what is being achieved for this investment within
12 universities and where both future current and capital investment might be best targeted to promote PA
13 engagement in the whole student population. Fifty-five million euros worth of investment for indoor and
14 outdoor PA facilities was planned by Irish universities from 2015 to 2019²⁴ so it is essential to understand
15 the impacts this spending is having on students' PA engagement. A high provision of staffing related to PA
16 engagement by universities decreased the likelihood of students being 'Active Commuters' or 'High Active'.
17 From a support perspective, research among adults with intellectual disabilities show that a lower provision
18 of staff can lead to a lack of assistance in ensuring safe and adequate PA for each person's individual
19 needs³⁷. However, these findings contradict this and show that increased staff may reduce PA engagement
20 in university students. Like with current investment, this study did not ask about the role of staff in each
21 university, so it could be possible that universities indicate a high provision of staffing but a proportion of
22 these are employed to work with a small population of student teams and athletes (i.e. recreational vs.
23 elite coaches). With students going through a transitional life period, associated with decreased PA^{6,7,8}, it is
24 important that universities consider the provision of staff and environments that support the whole
25 student population with being physically active.

1 The organisational structures within a university tend to offer a range of indoor and outdoor facilities for PA
2 engagement, which are supported by financial investments and allow for the running of clubs. Universities
3 with a moderate or high provision of indoor facilities were seen to increase the likelihood of students being
4 'Active Commuters', 'Active in University', or 'High Active', while a moderate or high provision of outdoor
5 facilities was seen to decrease the likelihood of students being in active clusters. It would be presumed that
6 an increase in facilities will result in increases in PA engagement, or as Sallis and colleagues (2001)
7 paraphrased "If we build it, they will come - and be active" (pg.619). For Irish students, weather was also
8 seen as one of the top barriers for not actively commuting to university²⁴, with it being a possible barrier for
9 outdoor recreational PA. Furthermore research involving students from Chile and Spain highlight the need
10 to consider the safety of environments offered regarding active commuting, including street crossings and
11 safe places to leave a bicycle³⁸.

12 Indoor facilities help get over the barrier of poor weather, which may be why an increase in its provision is
13 seen to have a positive influence on Irish students PA patterns. However, there may be a need for
14 universities to identify and promote lesser-known outdoor PA opportunities (e.g. walking trails, cycle tracks
15 etc.) since indoor facilities (e.g. pitches, courts etc.) can be more obvious but also utilised by university
16 teams or incur a cost to use, reducing accessibility. A high provision of sport clubs in universities increased
17 the likelihood of being 'Active Commuters', 'Active in University' and 'High Active'. Universities should
18 support the provision of a range of activities for varying levels of ability to cater for the individual needs and
19 interests of students. This may also create a "second chance" for those students who have dropped out of
20 PA participation due to limited opportunities or negative experiences during adolescents. Finally, the
21 results indicate that the perceived quality of provision offered for sport by universities matches the positive
22 PA patterns of students, while the same cannot be said for the perceived quality of provision offered for
23 PA. There may be a need for those responsible for the planning and support of PA opportunities to become
24 more informed regarding the current quality of provisions offered for broad PA engagement within
25 university settings and not just sport. One recommendation here is for organisational structures within a
26 university to work in partnership to understand and plan university-wide initiatives that support PA

1 engagement among the whole student population. This “joined up” thinking or systems approach is
2 endorsed in international guidance for PA promotion, such as the Global Action Plan on Physical Activity³⁹,
3 and in the UK through the Healthy Universities Framework²².

4 The methodology of this study allowed for the examination of environments provided by universities for PA
5 and students’ self-reported PA behaviours. This could be considered the studies biggest strength. However,
6 several limitations need to be acknowledged. First, the UEAT was designed to allow a score to be generated
7 for each KPI. Although useful, a number of KPIs are more in depth than others due to the questions that
8 formulate the scores, which needs to be considered when interpreting the findings. Also, the UEAT did not
9 capture other factors that may have influenced cluster membership. Our previous research²⁷ did
10 investigate the psychosocial factors related to cluster membership, however future research could explore
11 the wider environmental factors related to PA, such as those highlighted in general populations¹⁸. Second,
12 the capital investment indicator was removed as it would have meant reducing the number of universities
13 and participants included in the study. As mentioned, ensuring the ease of reporting capital investment in
14 future studies needs to be considered to improve response rates. Although the findings are useful, future
15 research also needs to investigate the purpose of current and capital spending by universities for the
16 construction of facilities, staffing and provision of initiatives to support the promotion of PA. Generating
17 this understanding can help to inform where future financial resources can be best utilised to encourage PA
18 engagement in the whole student population. Third, placing motorised transport and public transport into
19 the same category may not have adequately captured PA engagement, since evidence highlights higher PA
20 levels among those using public transport than those using motorised vehicles⁴⁰. Future research aiming to
21 understand the combination of PA behaviours should consider this to ensure activities related to public
22 transport are accounted for. Finally, this data was collected in 2014, which needs to be taken into
23 consideration due to potential changes to university environments that may currently facilitate or impede
24 PA engagement among students.

25

1 **Conclusion**

2 Certain aspects of the university environment for supporting PA engagement are associated with the PA
3 patterns of students and should be used to foster student engagement through both the transport and
4 recreational domains. It is important for universities to have organisational structures and partnerships in
5 place to understand and provide relevant PA opportunities along with adequate staffing, facilities, clubs
6 and financial resources to support PA engagement in the whole student population. Additional research is
7 needed to fully understand the role of the staff, facilities, and investment for PA engagement, and how
8 they can be used in optimal ways to help target a wide range of university students. Nevertheless, the
9 university campus has great potential for increasing student engagement in PA and these findings can help
10 inform future campus-wide initiatives that foster active student populations for improving overall long term
11 health.

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