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RESEARCH ARTICLE

Determinants of physical activities in settings (DE-PASS): Freshman university students with weight gain - A cross-sectional study

[version 1; peer review: 1 approved]

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v1 **First published:** 15 Apr 2025, **5**:106
https://doi.org/10.12688/openreseurope.19917.1
Latest published: 15 Apr 2025, **5**:106
https://doi.org/10.12688/openreseurope.19917.1

Abstract

Background

During the transition from adolescence to adulthood in university life, some students experience weight gain. The physical activity patterns of students who gain weight may differ from those who do not. This study aims to reveal the physical activity-related behaviors of students who gained and did not gain weight during first year of university.

Methods

A total of 69 weight-gained (study group) and 51 non-weight-gained (control group) students were included in the study. A semi-structured interview was used to determine the factors influencing physical activity. The International Physical Activity Questionnaire-Short Form (IPAQ) was used to evaluate physical activity levels. The body-esteem scale (BE), which has three parts—BE-appearance, BE-weight, and BE-attribution—and the body appreciation scale-2 (BSA-2) were used to understand body image and the participants' self-evaluation of their body and appearance.

Results

Changes in eating habits after entering university differed between groups (X^2=4.31, p=0.04). A lower percentage of students in the study group than in the control group were aware of their university's sports facilities (X^2=4.32, p=0.037). A greater percentage of students in the study group reported feeling bored when they did sport alone

Open Peer Review

Approval Status ✓

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version 1 15 Apr 2025	✓ view

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than did those in the control group (X^2=4.47, p=0.023). While most participants in the study group stated that they did not feel anxious or embarrassed about being observed during physical activity, the BAS-2 and BE-Appearance scores were significantly correlated with IPAQ total scores (r=0.26, p=0.02; r=0.37, p=0.003). Compared with weight-gained females, weight-gained males were more active in the study group (X^2=11.89, p=0.003). In control group activity levels of males and females did not differ (p<0.05).

Conclusion

The findings of this study indicate that the determinants of physical activity differ between students who gain weight and those who do not after entering university. Further research is needed to develop strategies to prevent weight gain among university students.

Keywords
exercise; young adult; sex characteristics

This article is included in the COST Actions gateway.

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Author roles: Çınar Medeni Ö: Conceptualization, Formal Analysis, Investigation, Methodology, Resources, Supervision, Writing – Original Draft Preparation, Writing – Review & Editing; **Dogan İE**: Conceptualization, Methodology, Project Administration; **Ozunlu Pekyavas N**: Methodology, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This project has received funding from the European Union's Framework Programme for Research & Innovation as part of the COST Action [CA19101 - Determinants of Physical Activities in Settings], as supported by the COST Association (European Cooperation in Science and Technology).
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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How to cite this article: Çınar Medeni Ö, Dogan İE and Ozunlu Pekyavas N. **Determinants of physical activities in settings (DE-PASS): Freshman university students with weight gain - A cross-sectional study [version 1; peer review: 1 approved]** Open Research Europe 2025, **5**:106 https://doi.org/10.12688/openreseurope.19917.1

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Introduction

When they transition from youth to adulthood during university life, university students have the opportunity to establish a foundation for adult life habits[1]. University students experience shifts in their roles within family and peer groups compared with high school students, allowing them greater autonomy over their lifestyles[2]. Having the opportunity to gain regular physical activity habits during this period will help individuals maintain physical activity during adulthood. In addition, university students may take on a role in the formation of social and cultural norms while acting as decision-makers or opinion leaders in society in the following years[3,4].

A review of 35,747 university students from various countries revealed that, on average, half of the students did not have sufficient physical activity[1]. Physical activity participation of university students is generally lower than the recommended level. Weight gain during the first year of university is commonly referred to as freshman weight gain. One study reported that 60.9% of students gain weight during the first year of university[5]. A meta-analysis identified stress, alcohol consumption, unhealthy eating habits, and decreased physical activity as contributing factors to weight gain in university students[6]. Furthermore, although the majority of adults recognize the health benefits of physical activity, the overall participation rate in daily physical activity remains below 50%[7]. European Union Council strategy plans emphasize the importance of identifying the determinants of physical activity as part of health promotion efforts[8]. Identifying these determinants is crucial for implementing strategies to encourage physical activity and reduce inactivity levels[9].

In adolescent groups, body image and appearance are determinants of physical activity. Poor body image can act as a barrier to participation in physical activity, particularly in mixed-gender or unfamiliar settings[10,11]. In addition, experiencing physical activity as a leisure activity, especially at an early age, is a facilitating factor in individuals' participation in physical activity and maintaining physical activity in later years[7]. Physical education classes in schools during childhood and adolescence have the potential to increase awareness of physical activity[8]. Despite the extensive literature on the determinants of physical activity, limited data exist on the specific factors influencing physical activity participation among university students who gain weight during their freshman year. Understanding the differences in physical activity determinants between students who gain weight and those who do not may help address one of the contributing factors to weight gain. Therefore, this study aimed to investigate differences in the determinants of physical activity between university students who reported gaining weight and those who did not gain weight during their freshman year. We hypothesized that the determinants of physical activity would differ between these two groups.

Methods

This was a cross-sectional study that was conducted between 25.09.2023 and 01.06.2024 at Baskent University. A priori sample size analysis was performed with the GPower 3.1.9.7 program. To have a power of 0.85 and an effect size of at least 0.3 (moderate), 100 participants needed to be included in the study. The inclusion criteria were being a university student and being 18–30 years old. The exclusion criteria were having any orthopedic, rheumatological, systemic, or neurological problem that would be a barrier to physical activity and having cognitive problems adapting to the semi-structured interview and International Physical Activity Questionnaire-Short Form (IPAQ). Students who were in their first year at university were not included because they did not complete the freshman year to report freshman weight gain and they have 'limited' experience as university students, as was the case in a previous study[12]. The research was announced at the university, and volunteers were invited to participate in the study. This study was reviewed and approved by the "Baskent University Institutional Review Board and Ethics Committee" (Project number: KA23/246, Approval date: 24. August. 2023). All participants were informed about the nature of the study and verbal and written consent were obtained. The study was conducted according to Declarations of Helsinki.

A semi-structured interview was used to determine the determinants of physical activity. Some of the questions were selected from the relevant literature[12], and a few specific questions were added to the interview question guide. The interview guide was tested by the research team, and after revisions, it was tested in a group of twenty university students[12]. The key question used to group the students was "Think back to first year of being a university student. Did you gain weight (at least 1 kg) after entering university?" After some introductory questions, key questions focused on the main purpose of this study, i.e., identifying factors influencing students' physical activity. Finally, the students were asked to share ideas concerning health promotion as well as intervention strategies to increase physical activity and decrease sedentary behavior in university students.

Because the International Physical Activity Questionnaire-Short Form (IPAQ) is one of the most reliable self-reported instruments for analyzing the physical activity level of university students[13], we used IPAQ to obtain information about physical activity level. The IPAQ total score and categorical score were calculated according to guidelines[14] and were used in the statistical analyses. The body appreciation scale-2 (BAS-2) was used to understand the features and potential outcomes of positive body image in both the study and control groups[15]. The body-esteem scale was used to analyze the participants' self-evaluation of their body and appearance, which has three parts: BE-appearance (general feelings about appearance), BE-weight (weight satisfaction), and BE-attribution (evaluations attributed to others about one's body and appearance)[16].

Statistical analyses were performed with the Jamovi 2.6.44 software. The chi-square test was used to determine if the determinants of physical activity and weight-related behaviors were different between groups. To analyze differences in IPAQ scores between the study and control groups, a Mann–Whitney U test was used because of the nonnormal distribution of the data. The relationships of the BAS-2, BE-Appearance, BE-Weight, and BE-Attribution scores with the IPAQ score were analyzed with Spearman's rho (for nonparametric situations) and the Pearson correlation coefficient (for

parametric situations) in the study and control groups. When investigating changes in the IPAQ total score, the effects of group, sex and other reported determinants of physical activity were analyzed via two-way ANOVA. An overall 5% type I error level was used to infer statistical significance.

Results

Volunteers were included in the study until 51 people were included in both groups. Among the 125 students, 5 were excluded from the study, and 69 of the students (49 women, 20 men) (age: 21.39±1.60, body weight: 75.28±17.81 kg, body mass index: 25.31±4.52) who reported gaining weight after entering university were grouped into the study group, and 51 of the students (37 women, 14 men) (age: 21.98 ±4.17 years, body weight: 63.56 ±18.25 kg, body mass index: 21.59 ±4.47) who reported not gaining weight after entering university were grouped into the control group.

The body weight of the control group (63.56 ± 18.25 kg) and the study group (75.28 ± 17.81 kg) differed significantly ($p = 0.001$). Similarly, the body mass index (BMI) of the control group (21.59 ± 4.47) and the study group (25.31 ± 4.52) showed a significant difference ($p < 0.01$). While the change in eating habits after entering university differed between the groups ($p=0.04$), the change in physical activity participation did not differ between the groups ($p> 0.05$). Most of the students in both the study group and the control group reported that they did not have enough time to participate in sports activities and had similar behavior regarding their participation in sports activities after school ($p> 0.05$). There was no difference in attendance at regular sports/physical activities between the groups ($p> 0.05$). In both groups, most of the students reported that longer school hours are a barrier to participating in sports activities ($p> 0.05$). In both the study and control groups, a greater percentage of students like to participate in sports activities with their friends ($p> 0.05$), and in the study group, a greater percentage of students are bored when they do sports alone ($p= 0.02$) than in the control group. In both groups, most students were encouraged to do sports when they were a child in their family. A lower percentage of students had information about their university's sports facilities in the study group than in the control group ($p= 0.03$) (Table 1).

Table 1. Differences in physical activity determinants and body weight between the study and control groups.

		Yes (%)	No (%)	Test statistics
Eating habits changed after entering university.	SG	63.8	36.2	X^2=4.31
	CG	44.9	55.1	**p=0.04***
Physical activity behavior changed after entering university.	SG	57.4	42.6	p>0.05
	CG	46.0	54.0	
Do you have enough time to exercise/do physical activity?	SG	33.3	66.7	p>0.05
	CG	39.6	60.4	
Do you participate in physical activity/sport regularly?	SG	34.8	65.2	p>0.05
	CG	31.8	68.8	
Does the length of school hours affect your participation in exercise/physical activity?	SG	85.4	14.6	p>0.05
	CG	80.9	19.1	
Is it fun to do sports with your friends?	SG	89.7	10.3	p>0.05
	CG	88.6	11.4	
Do you get bored when you do sports alone?	SG	50.7	49.3	X^2=4.47
	CG	30.6	69.4	**p=0.02***
Did your family encourage you to do sports when you were a child?	SG	88.4	11.6	p>0.05
	CG	80.9	19.1	
Do you have any information about the university's facilities for physical activity/sport?	SG	36.2	63.8	X^2=4.32
	CG	55.9	44.1	**p=0.03***
Do you feel embarrassed or anxious about other people seeing you during physical activity?	SG	22.4	77.6	p>0.05
	CG	13	87	

*Significant difference was found between groups ($p<0.05$). SG: study group. CG: Control group.

In total, 5 university students reported that alcohol consumption and cigarette use increased after they entered university, which might be related to changes in body weight. Two students reported fatigue, and one student reported insomnia as a factor related to body weight change after entering university. A total of 17.5% of the students (n=21) reported that having more stress at university was a factor related to body weight. Seven students reported self-control as an enabler factor for weight-related behaviors, and a few students reported economic situations and the long distance between home and university as barriers to participation in sports activities.

Two students' IPAQ scores and categorical levels were missing in the study group. The IPAQ total score was not different between the groups (p> 0.05). In the study group, although most of the participants reported that they did not feel anxious or embarrassed about other people seeing them during physical activity, the BSA-2 and BE-Appearance scores were correlated with the IPAQ total score (r=0.26, p= 0.02; r=0.37, p< 0.01). In the control group, there was no correlation among the BSA-2 score, BE appearance score, BE weight, BE attribution score, or IPAQ score (p> 0.05). The physical activity level categories of the two groups are given in Table 2. In the control group, sex did not affect the IPAQ category (p> 0.05); however, in the study group, sex affected the IPAQ category (X^2=11.89, p< 0.01) (Figure 1).

There was no significant difference in the IPAQ score by group (p> 0.05). Nevertheless, there was a significant difference by sex (F=9.09, p< 0.01), and the interaction between these terms was significant (F=5.81, p= 0.01), indicating that weight gain after entering university has different effects on the IPAQ score between males and females (Figure 2a). There was no significant difference in the IPAQ score by group (p> 0.05); however, there was a significant difference in the IPAQ score according to participation in sports activities regularly (F=13.58, p< 0.001) (Figure 2b), although the interaction between these terms was not significant (p> 0.05). There was no significant difference in the IPAQ score by group or parental encouragement during childhood, and the interaction effect between these terms was not significant (p> 0.05) (Figure 2c). There was no significant difference in the IPAQ score by group (p> 0.05). Nevertheless, there was a significant difference in the IPAQ score (F=5.53, p= 0.02), and the interaction effect between these terms was significant (F=5.07, p= .02) (Figure 2d). Students who are not bored when they do sport alone have

Table 2. Physical activity level categories according to the IPAQ.

	Low n (%)	Moderate n (%)	High n (%)	Total n (%)
SG	16 (23.8)	25 (37.3)	26 (38.8)	67 (100)
CG	9 (17.6)	28 (54.9)	14 (27.4)	51 (100)

*There were no differences between groups (p>0.05).

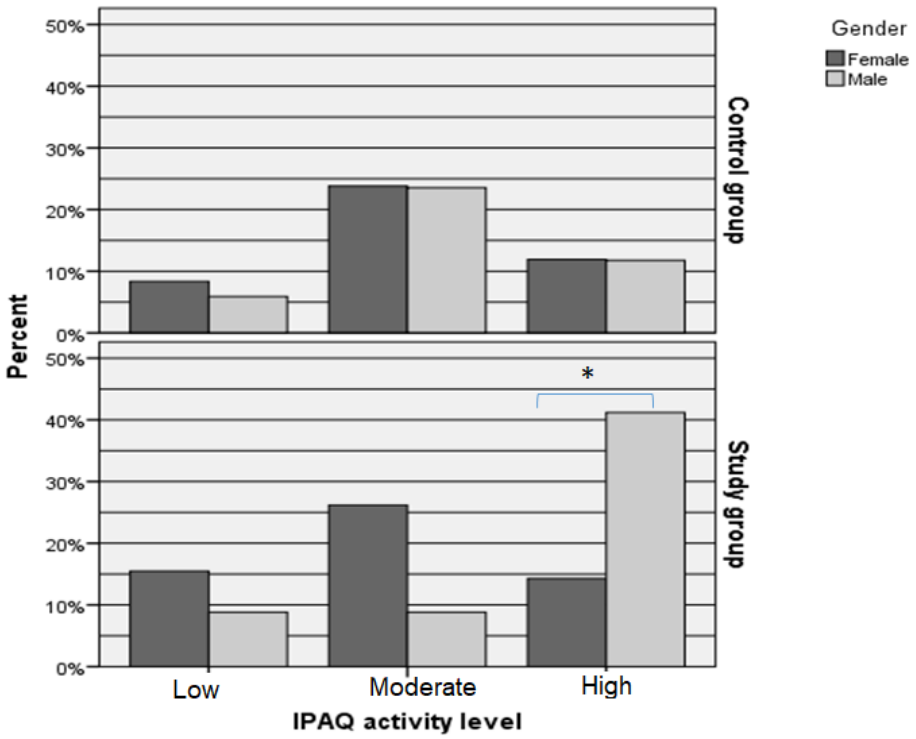


Figure 1. Effects of sex on physical activity level in both the study and control groups.

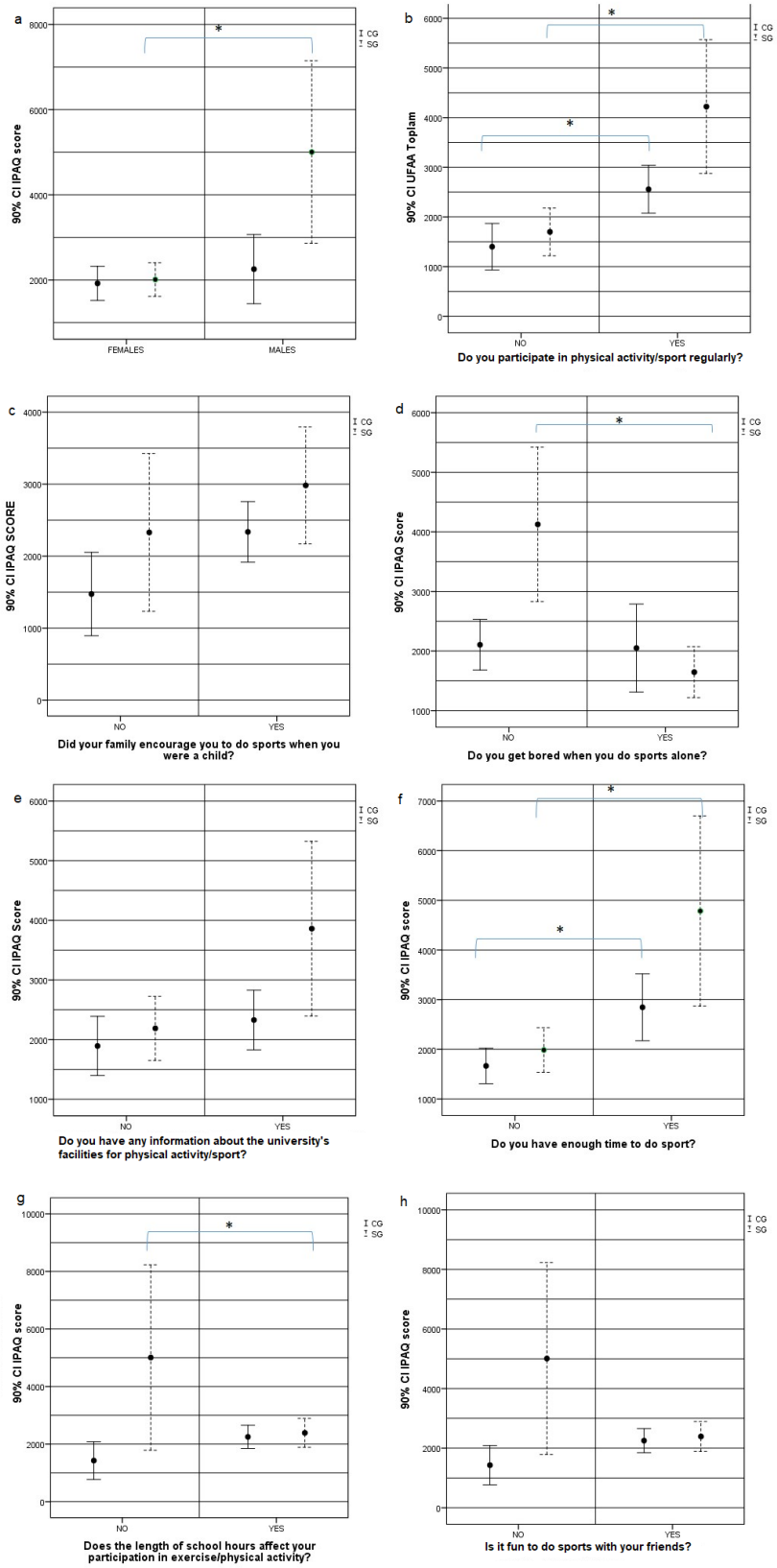


Figure 2. Effect of group and determinants of physical activity on the IPAQ scores of university students. *Significant difference was found between groups. CI: Confidence interval. IPAQ: International physical activity questionnaire.

higher IPAQ scores (p= 0.01). There was no significant difference in the IPAQ score by group or knowledge of physical activity-related facilities at university (p> 0.05), and the interaction effect between these terms was not significant (p>0.05) (Figure 2e). There was a significant difference in the IPAQ score by group (F= 4.57, p= 0.03) and time spent on sports (F=14.19, p< 0.001), and the interaction effect between these terms was not significant (p> 0.05) (Figure 2f). There was a significant difference in the IPAQ score by group (F=6.74, p= 0.01), but there was no difference in the number of school hours (p> 0.05), and the interaction effect between these terms was significant (F= 5.77, p=0.01) (Figure 2g). There was no significant difference in the IPAQ score by group or enjoyment of doing sports with friends (p> 0.05), and the interaction effect between these terms was not significant (p> 0.05) (Figure 2h). There was no significant difference in the IPAQ score by group or feeling anxious about being seen by other people during physical activity, and the interaction between these terms was not significant (p> 0.05).

Discussion

Weight gain is one of the leading health problems, and the prevention of weight gain rather than weight loss is most successful. Because low physical activity leads to weight gain, it is important to identify determinants of physical activity so that we may eliminate one of the factors leading to weight gain. Weight-gained students believe that changes in eating habits are related to weight gain after they enter university. A greater percentage of weight-gained students become bored when they do sports alone and do not have information about campus facilities related to physical activity. Being female, having long course hours, and being bored when doing sports alone had negative effects on IPAQ scores in weight-gained students but not in the control group. Not participating in sports regularly and not having time to do sports had negative effects on IPAQ scores in both groups.

Our results concerning changes in eating and physical activity levels after entering university were similar to those of previous studies[17], which reported that weight gain during university life is related to eating style but not to physical activity levels. Most of the students in our study reported that their eating habits changed after they entered university. It is expected that physical activity may be related to weight gain[18]; however, the university students included in this study believed that eating habits were the primary factor behind weight gain. Therefore, we believe that university students need to be informed about the effects of physical activity on body weight.

Our finding of a 34% regular sports attendance rate was similar to that of a study that reported an attendance rate of 26.4%[19] but lower than that of other studies that reported 48–69% attendance rates[20,21]. According to the IPAQ categorical score, 23.8% (n=16) of the patients in the study group and 17.6% (n=9) of those in the control group were inactive, which was higher than that reported in previous studies[22,23] but similar to that reported in another study[24]. The effect of gender on physical activity level in weight-gained university students has not been investigated to date. According to one study, 14% of males and 30% of females were inactive, and males performed more vigorous physical activity than females did[24]. Another study supported this finding[25], which aligns with the results of the weight-gained group in our study; however, in the control group, our results did not support the effect of sex on physical activity level. This is the first study that groups university students as weight-gained and not weight-gained during their freshman year, and our results revealed that weight-gained females tend not to perform vigorous physical activity, which has additional effects on cardiorespiratory fitness in young people[26]. Furthermore, weight-gained males had higher IPAQ scores than weight-gained females did, which may indicate that males are more likely to use physical activity as a strategy to lose weight.

Our results are consistent with those of previous studies[12,25], which reported that long course hours and not having time to do sports were barriers to physical activity. However, no studies have investigated differences in determinants between students who gain weight and those who do not gain weight during their freshman year at university. We believe that the reason we did not observe any differences between the study and control groups regarding long course hours as a barrier to physical activity is that course hours at university are similar for all the students included in the study.

Since enjoyment of physical activity is a key factor in preventing dropout from physical activity programs[27], we asked some questions to university students during the interviews. University students often prefer engaging in sports with their peers[20], a finding supported by our study across both groups. Additionally, our results revealed that a greater proportion of students in the weight-gained group reported feeling bored when exercising alone than did those in the control group. Notably, students who did not experience boredom while exercising alone had higher International Physical Activity Questionnaire (IPAQ) scores than those who did. This discrepancy may stem from the possibility that weight-gained students are more socially inclined and prefer exercising with peers. Sports are vehicles used to bring people together around the world[28]. Universities have some opportunities to do sports or physicalactivity that increases physical activity levels through peer interaction; however, some studies have reported that these opportunities do not reach students[12]. According to a meta-analysis, the effect of sports facilities at universities on the physical activity behavior of university students is unclear[29]. One study[12] reported that many students felt inadequately informed about available sports facilities, a finding that our study corroborated for the weight-gained group but not for the control group. Ensuring that all students are informed about on-campus physical activity opportunities is crucial for preventingweight gain. While other studies have explored determinants of physical activity among university students, they have not specifically addressed the influence of knowledge about university sports facilities on physical activity behavior[20–22,24].

Another noteworthy finding is that in both the study and control groups, most of the students reported that they did not feel anxious or embarrassed about their appearance while doing sports; however, poor body image and body esteem

negatively affected the IPAQ total score of weight-gained students. Previous research has shown that body image and self-esteem mediate physical exercise participation among university students[30], and 11% of university students do not use the university gym because of embarrassment[25]; however, no study has investigated differences between students who gain weight and those who do not gain weight during university. This study emphasized that body image and esteem are related to physical activity scores in the weight-bearing group. Our study highlights the relationships among body image, self-esteem, and physical activity levels in the weight-gained group, suggesting that therapeutic interventions to improve body image and self-esteem may encourage greater participation in physical activity. Goicoechea *et al.*[31] noted a concern for body image and negative changes in the perception of appearance during COVID-19 confinement in university students; however, they did not investigate weight-gained university students specifically. While our study was conducted after the COVID-19 confinement period, the long-term effects of confinement on body image perception, particularly among weight-gained students, may still be relevant.

Parental control during childhood has been identified as a determinant of physical activity among university students[12]. Conversely, our study did not align with Deliens *et al.*'s study[12], which showed that encouragement during childhood to do sports is not related to weight gain during the freshman year or the IPAQ score during university life. This discrepancy may be due to students being encouraged to participate in sports during childhood but failing to develop a lasting habit. Other studies have not explored the impact of childhood sports encouragement on physical activity levels and weight gain during the freshman year of university[19,21]. One study reported that the participation of relatives in physical activity is related to physical activity behavior in university students[20]; however, in this study, none of the students reported that physical activity is an enabler of physical activity.

This study highlights differences in the determinants of physical activity between university students who gained weight and those who did not, shedding light on the experiences of weight-gained students. As the first study to focus on the determinants of physical activity in weight-gained university students, our findings provide a foundation for future research. Ensuring that university students are adequately informed about on-campus sports opportunities may enhance physical activity participation and levels, particularly through socialization, which is especially important for weight-gained students. Providing sufficient information to university students about sports opportunities on campuses might improve their physical activity and physical activity level through socialization, which is important for weight-gained students. Additionally, our study is the first to identify that being female negatively impacts physical activity levels among weight-gained students.

One of the limitations of this study was its cross-sectional design, which was similar to related literature[19–21,25] but restricted the ability to establish causal relationships. Because we used an interview to obtain information about students' thoughts about physical activity determinants, it is possible that students answered what they considered to be "politically correct" rather than what they thought, assuming a response bias[20]. Although we selected questions from related literature and asked an open-ended question about the determinants of physical activity, other unexamined factors may influence physical activity levels.

Conclusion

The findings of this study suggest that the determinants of physical activity differ between university students who gained weight and those who did not during their freshman year. The results of the study can be generalized to male and female university students because we do not have trans-gender university students in this study[32]. Further studies are needed to analyze the effect of being trans-gender on differences in physical activity determinants between weight-gained and nonweight-gained university students.

Ethics approval and consent to participate

This study was reviewed and approved by the Baskent University Institutional Review Board and Ethics Committee (Project no: KA23/246) Approval date: 24. August. 2023). All participants were informed about the nature of the study and verbal and written consent were obtained.

Consent for publication

All authors have given their consent for publication in the ORE Journal.

Availability of the data

[figshare]:[DE-PASS]. https://doi.org/10.6084/m9.figshare.28532405[33].

The project contains the following underlying data:_- [DE-PASS]

-(underlying data.xlsx, descriptions of the underlying data.docx).

The project contains the following extended data

-STROBE_checklist_cross-sectional.docx,

-Extended data_body appreciation scale-2 Turkish version.docx,

-Extended data_Body esteem scaleTurkish version.pdf,

-Extended data_IPAQ_Turkish_self-admin_short.pdf,

-Extended data_Semi_structured_interview_Turkish_English.docx,

-ExtendedData_BAS2_English.docx,

-ExtendedDataBES_English.pdf ,

-ExtendedDataIPAQ_English_self-admin_short (1).doc)

Data are available under the terms of the Creative Commons Zero "No rights reserved" data waiver (CC0 1.0 Public domain dedication)(http://creativecommons.org/publicdomain/zero/1.0/).

Acknowledgements

None.

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Open Peer Review

Current Peer Review Status: ✔

Version 1

Reviewer Report 15 October 2025

https://doi.org/10.21956/openreseurope.21545.r61607

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✔ **Zehra Can Karahan**
Atilim University, Ankara, Turkey

The manuscript addresses an important public health issue related to physical activity and weight gain among university students. The study is methodologically sound, well-structured, and clearly written. However, some areas could be improved for better clarity and scientific rigor.
Since the word "Freshman" in the title refers to students who have just started university, there is no need to use the word "students" in the title.
Abstract: Since no intervention was made to the individuals in the study, they can be classified as those who gained weight and those who were at a stable weight, instead of the study and control groups. Physical activity and weight gain can be added to the keywords.
Introduction: The introduction is comprehensive, but the *rationale for focusing specifically on "freshman weight gain"* could be emphasized more clearly. You can abbreviate the International Physical Activity Short Form as IPAQ-SFand use the abbreviation elsewhere.
Results:Consider emphasizing key findings in the text rather than repeating all table data.
Please check the consistency of *p-value notation* (use either $p < 0.05$ or $p < .05$ throughout).

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and does the work have academic merit?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Physical activity, exercise, cardiopulmonary rehabilitation

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.