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Health-related lifestyle behaviour profiles and their associations with mental health and academic burnout in online university students: a latent profile analysis

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Abstract

Background: Online university students often combine academic demands with work and family responsibilities. This study aimed to identify health-related lifestyle behaviour profiles among Spanish online university students and examine their associations with mental health symptoms and academic burnout.

Methods: A cross-sectional study included 2,204 students enrolled in fully online degree programmes (75.3% women; mean age = 34.66 years, SD = 9.15). Participants completed self-report questionnaires assessing physical activity, screen time, Mediterranean diet adherence, sleep problems, stress, anxiety, depression, and academic burnout. Latent profile analysis used physical activity, screen time, diet adherence, and sleep problems as indicators. Outcome differences between profiles were examined using the Bolck–Croon–Hagenaars method without sociodemographic adjustment.

Results: Three profiles were identified: (1) lower physical activity with intermediate values for the remaining indicators; (2) higher physical activity and Mediterranean diet adherence, with the lowest screen time and sleep problems; and (3) very high physical activity and Mediterranean diet adherence, with intermediate screen time and sleep problems. Profiles differed primarily in physical activity. Profile 1 reported significantly higher stress, anxiety, depression, and emotional exhaustion than Profile 2. No statistically significant omnibus differences were observed for cynicism or academic efficacy. Findings involving Profile 3 were considered exploratory because of its small size (n = 35; 1.6%).

Conclusions: Health-related lifestyle behaviour profiles were associated with mental health symptoms and emotional exhaustion among online university students. These findings represent unadjusted cross-sectional associations and require cautious interpretation, particularly regarding the smallest profile.

INTRODUCTION

Online higher education has contributed to widening access to university for a diverse student population [1]. This population includes many non-traditional students, a broad group commonly characterised by older age, interrupted educational trajectories, employment, and family responsibilities [2]. These circumstances are particularly relevant when studying students enrolled in online programmes, as available time, personal organisation, and work or family responsibilities may shape their educational experience [3]. Online study also involves sustained interaction with digital environments and substantial periods of screen-based activity [4]. In addition, participation in virtual learning environments requires students to organise academic work and manage the boundaries between educational demands and personal life [5]. Thus, these characteristics provide an important contextual framework for examining health-related lifestyle behaviours and academic experiences among online university students [6].

This context is crucial for understanding the mental health and academic well-being of university students. A recent umbrella review reported a high prevalence of symptoms of depression, anxiety, sleep

problems, and stress in this population [7]. In addition to these indicators of psychological distress, academic burnout provides a distinct perspective on the strain associated with the university experience, which is generally reflected in emotional exhaustion, cynicism, and low academic efficacy [8]. Furthermore, during the COVID-19 pandemic, when university teaching was conducted largely remotely, high prevalence rates of academic burnout were estimated, with 56.3%, 55.3%, and 41.8% of students reporting emotional exhaustion, high cynicism, and low personal fulfilment, respectively [9]. Notably, academic burnout does not stem from a single cause, but is linked to a combination of academic, personal, and contextual factors within which the educational experience takes place [10].

Within this framework, health-related lifestyle behaviours provide a useful basis for examining mental health and academic well-being. Higher levels of physical activity have been associated with lower anxiety, depression, and stress among university students [11], while exercise-based interventions have also shown favourable effects on mental health in this population [12]. Screen time requires more cautious interpretation in online students. Although excessive screen exposure has been associated with poorer mental health, sleep quality, and academic performance [13], screen use is also an inherent component of fully online education and therefore cannot be considered an adverse behaviour per se. Sleep represents another relevant lifestyle domain, as sleep problems have been associated with psychological distress [14] and higher stress among university students [15]. Dietary behaviour provides a complementary dimension, with greater adherence to the Mediterranean diet associated with more favourable lifestyle characteristics and indicators of mental and emotional well-being among Spanish university students [16]. These behaviours may coexist in different configurations rather than occurring independently [17].

Analysing each behaviour independently may offer a limited view of a person's lifestyle. Health-related behaviours tend to cluster into patterns in which protective behaviours may coexist with less favourable ones [17, 18]. In this regard, profiles characterised by an overall healthier configuration have been associated with lower levels of depression, anxiety, and psychological distress [19]. Therefore, understanding how these behaviours co-occur may prove more revealing than analysing each behaviour in isolation. Within this approach, person centred methods allow for the identification of subgroups of individuals who share similar patterns within a heterogeneous population [20]. Among these methods, latent profile analysis is particularly well-suited, as it enables the detection of unobserved groupings based on continuous indicators [21]. Its application to university populations has begun to yield compelling evidence, identifying lifestyle profiles linked to mental health and physical activity [22, 23]. In a complementary manner, Webster et al. [24] analysed distinct patterns of physical activity, screen time, sleep, and dietary habits in school-age populations, reinforcing the value of studying these behaviours from an integrated and configurational perspective.

Despite these advances, there is still limited evidence on how health-related lifestyle behaviours co-occur among online university students and how the resulting configurations are associated with mental health and academic burnout. Therefore, the aim of this study was to identify latent health-related lifestyle behaviour profiles among Spanish online university students based on physical activity, screen time,

sleep problems, and adherence to the Mediterranean diet, and to examine whether these profiles differed in stress, anxiety, depression, and dimensions of academic burnout. Previous research has examined associations between health-related behaviours and mental health among tertiary education students [25], while profile-based studies have examined how multiple lifestyle behaviours co-occur within general university or school-age populations [18, 22, 23, 24]. The present study extends this work by applying a person-centred approach within a large sample of fully online university students. Importantly, the study was not designed to determine whether the identified patterns are specific to online rather than face-to-face education, as no comparison group was included. Rather, the online setting defines the population and educational context in which the lifestyle profiles were examined. It was hypothesised that profiles characterised by a more favourable configuration of health-related lifestyle behaviours would show lower levels of stress, anxiety, depression, and emotional exhaustion.

METHOD

Participants

A cross-sectional study was conducted using non-probability convenience sampling. A total of 2,480 students initially accessed the questionnaire. After excluding incomplete responses, the final sample comprised 2,204 Spanish university students (1,660 women and 544 men; mean age = 34.66 years, SD = 9.15, age range = 18–73 years) enrolled in fully online degree programmes. No a priori sample-size calculation was performed. The sample size was determined by the number of complete responses received from eligible students during the data collection period (May–June 2024). All complete responses from eligible participants were included in the analyses. The study population included students enrolled during the 2023–2024 academic year in programmes across the Faculties of Education, Law, Health Sciences, and Business and Communication at an international university from Spain. All degree programmes were delivered entirely online via virtual learning environments and digital resources. Regarding employment status, the vast majority of participants were employed (80.9%), followed by full-time students (9.9%), unemployed individuals (8.7%), and retirees (0.4%). In terms of living arrangements, 55.8% lived with a partner, 26.2% lived with their parents, 13.9% lived alone, and 3.7% shared accommodation with friends. Finally, regarding parental status, 64.0% of the sample had no children, whereas 16.3% had two children, 15.3% had one child, 3.8% had three children, and 0.6% had four or more children.

Instruments and variables

The instruments and variables were organised according to their role in the analyses. Physical activity, screen time, sleep habits, and adherence to the Mediterranean diet were considered explanatory variables and were used as indicators in the latent profile analysis, whereas mental health indicators and academic burnout were considered outcome variables and were examined as distal outcomes.

A) Explanatory variables

Physical activity levels

Physical activity levels were assessed using the International Physical Activity Questionnaire-Short Form (IPAQ-SF) [26], in its Spanish version validated in a Spanish university population by Rodríguez-Muñoz et al. [27]. This self-report instrument records the weekly frequency and daily duration of physical activity performed over the past seven days at three intensities: walking, moderate physical activity, and vigorous physical activity. Based on these responses, MET-minutes per week (MET-min/week) were calculated following the instrument's standard scoring protocol: walking = 3.3 × minutes × days; moderate activity = 4.0 × minutes × days; and vigorous activity = 8.0 × minutes × days. Total physical activity scores were computed by summing the MET-min/week values across all three intensities, using the total score as a continuous indicator within the latent profile analysis.

Screen time

Screen time was measured using the questionnaire developed by Vizcaino et al. [28], which evaluates different types of screen use in adult populations. The instrument includes 18 items assessing screen use across five categories: television, devices connected to the television, laptops/desktop computers, smartphones, and tablets. Scores were expressed as average minutes per day. A weighted average daily screen time score was calculated by combining weekday and weekend use according to the number of weekdays and weekend days, thereby obtaining an overall estimate of average daily screen exposure. The measure captured total screen exposure and did not distinguish between academic and recreational screen use.

Sleep habits

Sleep habits were assessed using the Pittsburgh Sleep Quality Index (PSQI) [29], validated in the Spanish population by Royuela Rico and Macías Fernández [30]. The instrument comprises 19 self-reported items organised into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component is scored from 0 to 3, and the seven component scores are summed to obtain a global score ranging from 0 to 21, with higher scores indicating greater sleep problems. The global PSQI score was retained as a broad composite indicator of sleep problems in accordance with the standard scoring structure of the instrument. In the present sample, internal consistency of the global score was modest (Cronbach's $\alpha = .62$). Consequently, findings involving the sleep indicator should be interpreted with appropriate caution.

Adherence to the Mediterranean diet

Adherence to the Mediterranean diet was assessed using the Mediterranean Diet Adherence Screener (MEDAS), developed and validated in Spain by Schröder et al. [31]. The screener comprises 14 items assessing consumption of key components of the Mediterranean dietary pattern and relevant food-related practices. Adherence to the Mediterranean diet was included as a profile indicator because

dietary behaviour represents a distinct health-related lifestyle domain complementary to physical activity, screen exposure, and sleep. Its inclusion therefore allowed the latent profile analysis to capture a broader configuration of co-occurring lifestyle behaviours rather than focusing exclusively on movement- and screen-related behaviours. Because the MEDAS is conceptualised as a formative index representing diverse dietary behaviours rather than a reflective latent construct, internal consistency coefficients such as Cronbach's alpha were not considered appropriate.

B) Outcome variables

Mental health indicators

Psychological distress symptoms were assessed using the Depression, Anxiety and Stress Scale (DASS-21), originally developed by Lovibond and Lovibond [32], translated into Spanish by Daza et al. [33], and validated in Spanish university students by Fonseca-Pedrero et al. [34]. This instrument measures negative emotional states experienced during the past week via 21 items scored on a four-point Likert scale from 0 ("did not apply to me at all") to 3 ("applied to me very much or most of the time"). The scale comprises three seven-item subscales: depression, anxiety, and stress. Following standard scoring procedures, raw scores for each subscale were multiplied by two to allow comparison with the full-length DASS-42. In the present sample, internal consistency was satisfactory for all subscales: stress (α = 0.89), anxiety (α = 0.83), and depression (α = 0.89).

Academic burnout

Academic burnout was evaluated using the Spanish version of the Maslach Burnout Inventory-Student Survey (MBI-SS) [8], an adaptation of the MBI General Survey designed specifically for students. A license to administer the Maslach Burnout Inventory was obtained from Mind Garden, Inc. This instrument measures academic burnout across three main dimensions: emotional exhaustion (5 items), cynicism (4 items), and academic efficacy (6 items). The items are rated on a seven-point Likert scale ranging from 0 ('never') to 6 ('always'). Total scores range from 0 to 30 for emotional exhaustion, from 0 to 24 for cynicism, and from 0 to 36 for academic efficacy. Higher scores on emotional exhaustion and cynicism, together with lower scores on academic efficacy, indicate greater academic burnout. Internal consistency in this sample was robust: cynicism (α = 0.92), emotional exhaustion (α = 0.92), and academic efficacy (α = 0.84).

Procedure

The study was conducted in strict accordance with the ethical standards of the Declaration of Helsinki. Ethical approval was granted by the Institutional Research Ethics Committee (protocol code: PI031_2023) in July 2023. Participants were recruited via institutional channels, including university email, the virtual campus, and mobile messaging applications, with all communications coordinated and authorised by the respective faculties and the Vice-Rectorate for Research.

The electronic questionnaire was hosted on SurveyMonkey (SurveyMonkey Inc., San Mateo, CA, USA), and a unique access link was distributed alongside detailed information regarding the study objectives. Prior to starting the survey, all participants provided informed consent through a mandatory online form. The self-administered questionnaire could be completed individually on any internet-enabled device (e.g., smartphone, tablet, or computer), ensuring flexible participation without geographical constraints. To maintain data integrity, responses were limited to one per participant. Anonymity and data confidentiality were strictly guaranteed throughout the process, which took place between May and June 2024.

Data analysis

Statistical analyses were performed using Mplus version 7.3 [35]. To test the hypotheses, latent profile analysis (LPA), a person-centred multivariate technique used to identify unobserved subgroups based on continuous observed indicators, was conducted [21]. Due to the large numerical range of the raw physical activity (MET-min/week) and screen time scores, both variables were linearly rescaled by dividing their values by 100 prior to model estimation. This transformation was used to reduce numerical scale differences between indicators and facilitate model estimation. Importantly, dividing the variables by 100 changes their units of measurement but does not standardise their variances. Therefore, the procedure should be understood as linear rescaling rather than variance standardisation.

Successive latent profile models ranging from one to five profiles were estimated. Model selection was based on the combined consideration of statistical fit, classification quality, parsimony, profile size, and substantive interpretability rather than on any single statistical criterion [21]. Model fit was evaluated using log-likelihood, the Akaike Information Criterion (AIC) [36], the Bayesian Information Criterion (BIC) [37], the sample-size adjusted BIC (ABIC) [38], entropy, and the Lo–Mendell–Rubin likelihood ratio test (LMR-LRT) [39]. Lower AIC, BIC, and ABIC values indicate comparatively better fit, whereas higher entropy values indicate greater classification accuracy. The LMR-LRT was used to compare a k-profile model with a (k − 1)-profile model. Profile size and substantive distinctiveness were also considered when selecting the retained solution. The overall sample was large (N = 2,204); however, sample-size requirements in LPA depend on factors such as profile separation and relative profile size [40]. Accordingly, a large total sample does not eliminate uncertainty associated with very small individual profiles, which was considered when interpreting profile-specific estimates. Regarding indicator selection, four continuous indicators representing complementary health-related lifestyle domains were included: physical activity, screen time, sleep problems, and adherence to the Mediterranean diet. This parsimonious indicator set was used to represent multiple lifestyle domains while limiting model complexity [41]. Finally, to examine profile differences across distal outcomes, the Bolck–Croon Hagenaars (BCH) auxiliary method was implemented [42]. This approach accounts for classification uncertainty when comparing distal outcomes across profiles without altering the original latent profile solution [43].

RESULTS

Latent Profile Analysis

Table 1 presents the fit indices for the one- to five-profile solutions. AIC, BIC, and ABIC decreased progressively as additional profiles were estimated, indicating that these information criteria did not identify a clear optimal solution within the range of models examined. The three-profile solution nevertheless showed high classification accuracy (entropy = .914) and provided a parsimonious and substantively interpretable representation of the observed data. The two-profile solution provided less differentiation in the configuration of lifestyle behaviours, whereas solutions with additional profiles did not provide sufficient substantive gain to justify the increased model complexity. Therefore, the three-profile solution was retained on the basis of the combined consideration of statistical fit, classification quality, parsimony, and substantive interpretability. Importantly, given that the information criteria continued to improve with additional profiles and that the LMR-LRT did not unequivocally favour the three-profile solution, the retained solution should be interpreted as a parsimonious descriptive representation of the data rather than as a uniquely established latent structure.

Table 1
Fit indices for latent profile analysis models.

No. of profiles	**1**	**2**	**3**	**4**	**5**
No. of free parameters	8	13	**18**	23	28
Log-likelihood	-26212.42	-25835.27	**-25659.97**	-25522.76	-25430.27
AIC	52440.84	51696.53	**51355.95**	51091.52	50916.54
BIC	52486.42	51770.60	**51458.51**	51222.57	51076.09
ABIC	52461.00	51729.30	**51401.32**	51149.50	50987.13
Entropy	-	0.972	**0.914**	0.871	0.869
LRT (LMR)	-	-	**341.71**	267.48**	180.29

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; ABIC = sample-size adjusted Bayesian information criterion; LMR-LRT = Lo–Mendell–Rubin adjusted likelihood ratio test. **p < .01. The retained three-profile solution is shown in bold.

As shown in Table 2, three profiles of health-related lifestyle behaviours were identified. Profile 1, labelled the “lower-activity / intermediate lifestyle profile” (n = 1,896; 86.0%), comprised the vast majority of participants and was characterised primarily by lower physical activity, together with intermediate levels of screen time, Mediterranean diet adherence, and sleep problems. Profile 2, labelled the “more favourable lifestyle profile” (n = 273; 12.4%), showed moderate-to-high levels of physical activity and Mediterranean diet adherence, alongside the lowest levels of screen time and sleep problems. Profile 3, labelled the “high-activity mixed lifestyle profile” (n = 35; 1.6%), represented a small and mixed configuration, combining the highest levels of physical activity and Mediterranean diet adherence with

moderate-to-high levels of screen time and sleep problems. The profiles were differentiated most clearly by physical activity, whereas differences in screen time, Mediterranean diet adherence, and sleep problems were comparatively smaller. Accordingly, the profile labels are intended as descriptive summaries of the overall configurations rather than as classifications of participants as uniformly healthy or unhealthy.

Table 2

Estimates of latent lifestyle scores within the profiles for the LPA model.

Variable	**1) Lower-activity / intermediate lifestyle profile (n = 1896, 86.0%)**	**2) More favourable lifestyle profile (n = 273, 12.4%)**	**3) High-activity mixed lifestyle profile (n = 35, 1.6%)**
	M (SE)	**M (SE)**	**M (SE)**
Physical Activity	14.34 (0.80)	53.92 (4.25)	127.61 (12.99)
Screen Time	5.20 (0.08)	4.61 (0.19)	4.97 (0.69)
Adherence to the Mediterranean Diet	8.13 (0.05)	8.65 (0.12)	8.91 (0.26)
Sleep Problems	6.86 (0.10)	5.75 (0.23)	6.83 (0.69)

Note. Physical activity and screen time values are presented after linear rescaling by dividing raw scores by 100. Screen time refers to average minutes per day.

Profile differentiation across mental health and academic burnout

To examine the differentiation between the identified profiles in greater depth, mean differences in psychological distress indicators (stress, anxiety, and depression) and academic burnout dimensions (academic efficacy, cynicism, and emotional exhaustion) were analysed using the BCH procedure with Wald's chi-square test (see Table 3). Omnibus Wald tests revealed significant differences between profiles in stress, $\chi^2(2) = 30.91$, $p < .001$; anxiety, $\chi^2(2) = 25.40$, $p < .001$; depression, $\chi^2(2) = 28.12$, $p < .001$; and emotional exhaustion, $\chi^2(2) = 42.05$, $p < .001$. Pairwise post hoc comparisons showed that Profile 1 exhibited significantly higher levels of psychological distress (stress, anxiety, and depression) and emotional exhaustion than Profile 2 (all $p < .001$). No significant differences were observed between Profile 1 and Profile 3, or between Profile 2 and Profile 3, regarding these outcomes.

Table 3

Differences in mental health and academic burnout outcomes across latent profiles using the BCH method.

Variable	Profile 1	Profile 2	Profile 3	χ^2 overall (2)	*p*	P1 vs P2	P1 vs P3	P2 vs P3
Stress	6.11 (0.11)	4.32 (0.29)	5.49 (0.73)	30.91***	< .001	30.48***	0.72	2.18
Anxiety	3.30 (0.09)	2.15 (0.20)	3.02 (0.54)	25.40***	< .001	25.33***	0.26	2.22
Depression	3.58 (0.10)	2.22 (0.23)	2.98 (0.62)	28.12***	< .001	27.63***	0.91	1.31
Academic Efficacy	27.25 (0.16)	26.94 (0.53)	29.96 (1.14)	5.87†	.053	0.30	5.51*	5.60*
Cynicism	3.98 (0.14)	3.35 (0.37)	3.10 (1.05)	2.94	.230	2.33	0.68	0.05
Emotional Exhaustion	14.73 (0.20)	11.04 (0.51)	13.65 (1.43)	42.05***	< .001	41.76***	0.56	2.90

Note. χ^2 = Wald chi-square statistic from the BCH procedure. *p < .05; ***p < .001. Pairwise comparisons for academic efficacy should be interpreted as exploratory, as the omnibus test was not statistically significant (p = .053).

Regarding academic efficacy, the omnibus Wald test did not reach the conventional threshold for statistical significance, $\chi^2(2) = 5.87$, p = .053. Pairwise comparisons yielded differences between Profile 3 and Profile 1, $\chi^2(1) = 5.51$, p < .05, and between Profile 3 and Profile 2, $\chi^2(1) = 5.60$, p < .05. However, given the non-significant omnibus test and the very small size of Profile 3 (n = 35; 1.6%), these pairwise findings were treated as exploratory and were not interpreted as confirmatory evidence of between-profile differences in academic efficacy. No significant overall differences were observed for cynicism, $\chi^2(2) = 2.94$, p = .230.

DISCUSSION

The study aimed to identify latent profiles of health-related lifestyle behaviours among online university students and to analyse their association with indicators of mental health and academic burnout. Our main results indicate that health-related lifestyle behaviours among online university students are not uniformly distributed but instead cluster into distinct configurations that are differentially associated with mental health and academic burnout. Specifically, three distinct profiles were identified based on physical activity, screen time, sleep problems, and adherence to the Mediterranean diet. These patterns were differentially associated with psychological distress and emotional exhaustion. The most favourable lifestyle behaviour configuration presented lower levels of stress, anxiety, depression, and emotional exhaustion than the most common profile, which was characterised mainly by lower physical

activity and intermediate values across the remaining indicators. These findings are consistent with recent calls for integrated, multi behaviour approaches to university students' mental health, particularly those emphasising the combined assessment of lifestyle behaviours such as physical activity, sedentary behaviour, diet, and sleep in university populations [44].

Beyond the statistical identification of the three-profile solution, the substantive interpretation of each profile provides insight into how health-related lifestyle behaviours co-occur among online university students. Profile 1 comprised the vast majority of the sample and was characterised primarily by lower physical activity, together with intermediate values for screen time, sleep problems, and adherence to the Mediterranean diet. Profile 2 showed a comparatively more favourable configuration, combining moderate-to-high physical activity and Mediterranean diet adherence with the lowest screen time and sleep problems. Profile 3 showed a minority mixed configuration, combining the highest levels of physical activity and Mediterranean diet adherence with moderate-to-high screen time and sleep problems. This pattern illustrates that more and less favourable lifestyle characteristics may coexist within the same individual-level configuration, consistent with previous profile-based research showing combinations of health-promoting and less favourable behaviours within the same lifestyle pattern [23]. However, because Profile 3 included only 35 participants, its substantive interpretation should remain exploratory.

The identification of these three profiles underlines that health-related lifestyle behaviours among online university students are not uniformly organised. The coexistence of protective behaviours and risk factors within the same profile reinforces the usefulness of person-centred approaches, as they enable the identification of previously unobserved subgroups within a heterogeneous population based on various indicators [21]. This finding aligns with recent evidence suggesting that lifestyle behaviours tend to cluster into distinct combinations and that healthier profiles are associated with lower levels of depression, anxiety, and psychological distress [19]. In a university population, Maitiniyazi et al. [22] identified profiles based on physical activity, diet, sleep, sedentary behaviour, and screen time, observing differences in depression, anxiety, and stress. Similarly, Webster et al. [24] described comparable profiles in a school-age population, associated with mental health and school satisfaction. However, evidence specifically focused on online university students remains limited.

Regarding mental health, Profile 2 showed lower levels of stress, anxiety, and depression than Profile 1. This pattern is consistent with previous studies reporting associations between combined health-behaviour patterns and psychological distress in university populations [45]. Physical inactivity and sedentary behaviour have been associated with greater psychological distress [46], while poor sleep quality and insomnia symptoms have been associated with higher stress [15]. Excessive screen time has also been examined in relation to poorer mental health, sleep quality, and academic performance [13], whereas Mediterranean diet adherence has been associated with more favourable indicators of mental and emotional well-being [16]. The present findings are consistent with considering these behaviours jointly; however, the cross-sectional design does not permit conclusions regarding their direction, cumulative effects, or underlying mechanisms.

Profile 1 was the largest group and was distinguished most clearly by its lower level of physical activity relative to the other profiles. Low physical activity and high sedentary time have been widely documented among university students [47, 48]. In Spanish university populations, sedentary behaviour and insufficient physical activity have also been frequently reported [49], while perceived lack of time and motivation have been identified as barriers to physical activity participation [50]. Screen-based academic activity is particularly relevant in distance education [4], and periods of online learning have been associated with lower physical activity and greater electronic device use [51]. Nevertheless, because the present study did not include a face-to-face comparison group or distinguish academic from recreational screen use, it cannot determine whether the observed behavioural pattern is attributable to the online educational format.

Profile 3 requires particularly cautious interpretation because it included only 35 participants (1.6% of the sample). The small class size increases uncertainty around its parameter estimates and limits the reliability and generalisability of comparisons involving this profile. Profile 3 did not differ significantly from the other profiles in stress, anxiety, depression, or emotional exhaustion. Although pairwise comparisons suggested higher academic efficacy in Profile 3, the overall omnibus test did not reach the conventional threshold for statistical significance ($p = .053$). Accordingly, this finding should be considered exploratory rather than confirmatory. From a descriptive perspective, the coexistence of very high physical activity and Mediterranean diet adherence with higher screen exposure and sleep problems is consistent with previous evidence showing that favourable and less favourable lifestyle behaviours may coexist within the same profile [24, 45, 52]. Previous studies have independently associated physical activity with favourable stress, recovery, and academic indicators [53], Mediterranean diet adherence with mental health indicators [54], and sleep problems and excessive screen exposure with less favourable psychological or academic outcomes [13, 15]. However, these previous associations should not be used to explain the pattern observed in Profile 3, and the present cross-sectional study cannot establish how the individual behaviours within this profile relate to its distal outcomes.

Regarding academic burnout, between-profile differences were concentrated primarily in emotional exhaustion. This finding is consistent with the conceptualisation of academic burnout in which emotional exhaustion, cynicism, and academic efficacy represent related but distinct dimensions [8]. In the present study, Profile 1 showed higher emotional exhaustion than Profile 2. Previous research has reported associations between life stress and academic burnout [55], between sleep problems and emotional exhaustion [56], and between physical exercise and academic burnout [57]. Associations involving Mediterranean diet adherence and burnout have also been reported in models incorporating physical activity, diet, and body-related indicators [58], while prolonged online activity has been examined in relation to digital burnout among students [59]. These findings provide relevant context for interpreting the present between-profile differences, but they do not establish the mechanisms underlying the higher emotional exhaustion observed in Profile 1. Given the cross-sectional design, it is not possible to determine whether the lifestyle configuration preceded emotional exhaustion, resulted from it, or whether both were associated with other unmeasured characteristics. In contrast, no significant between-profile differences were found for cynicism. This may reflect the fact that cynicism represents

an attitudinal dimension of burnout and has been associated with academic and motivational factors such as support, academic demands, resources, and engagement [60, 61], although these potential explanations were not directly examined in the present study.

From an applied perspective, the findings highlight the potential value of considering multiple lifestyle domains when characterising the health-related behaviours of online university students. The identified profiles suggest that students with similar levels in one behaviour may differ in other lifestyle domains, supporting a multidimensional rather than single-behaviour perspective when describing this population. However, the present observational findings do not provide evidence regarding the effectiveness of specific interventions or justify prioritising particular intervention strategies for individual profiles. Intervention studies would be required before such recommendations could be made.

This study has several notable strengths. Firstly, it included a large sample size, which allowed for a more robust analysis of the heterogeneity of online university students. It also focused on a non-traditional population that has received less attention than face-to face students, and integrated various modifiable health-related lifestyle behaviours, such as physical activity, screen time, sleep problems, and adherence to the Mediterranean diet, alongside indicators of mental health and academic burnout. Furthermore, latent profile analysis enabled a person-centred approach, suitable for identifying lifestyle behaviour configurations that may remain hidden in variable-centred analyses. Finally, the use of the BCH procedure to compare distal outcomes enhances analytical rigour by examining differences between profiles without re-estimating the solution or substantially modifying the initial model.

Several limitations should be considered when interpreting the findings. First, the cross-sectional design precludes causal or directional conclusions regarding the associations between lifestyle profiles, mental health, and academic burnout. Second, all variables were assessed using self-report measures and may therefore be affected by recall bias, social desirability, and common method variance. Third, screen time represented total daily screen exposure and did not distinguish between academic and recreational use. This limitation is particularly relevant in a fully online university population, where substantial screen exposure is inherent to the educational format. Fourth, the internal consistency of the PSQI global score was modest ($\alpha = .62$), which may have reduced the precision of the sleep indicator. Fifth, the sample was predominantly female and included a high proportion of employed students and participants with family responsibilities. These sociodemographic characteristics may be associated with both lifestyle behaviours and mental health or academic burnout. Because their contribution to profile membership and distal outcomes was not examined, residual confounding by sociodemographic characteristics cannot be excluded. Sixth, the profiles were differentiated primarily by physical activity, with comparatively smaller differences in screen time, Mediterranean diet adherence, and sleep problems. Their interpretation as multidimensional lifestyle configurations should therefore remain cautious. Seventh, participants were recruited from a single fully online university, which limits generalisability to other institutions and educational settings. Finally, Profile 3 comprised only 35 participants (1.6%), resulting in substantial uncertainty around estimates involving this profile. Findings relating to this group should therefore be considered exploratory until replicated in independent samples.

Future research should replicate these findings across diverse online universities and cultural contexts to examine the stability of the identified profiles. Longitudinal designs, such as Latent Transition Analysis (LTA), would help determine how health-related lifestyle configurations evolve over time and how these changes relate temporally to mental health and academic burnout. Future studies should also incorporate objective or complementary measures of physical activity, sleep, and screen exposure, distinguish between academic and recreational screen time, and examine the contribution of sociodemographic characteristics such as age, gender, employment status, parental status, and living arrangements. Replication using alternative approaches to indicator scaling would also help determine the robustness of the identified profile structure. Finally, experimental research would be required to determine whether modifying individual or combined lifestyle behaviours produces changes in mental health or academic burnout.

CONCLUSIONS

This study identified three health-related lifestyle behaviour profiles among Spanish online university students based on physical activity, screen time, sleep problems, and adherence to the Mediterranean diet. The predominant profile was characterised primarily by lower physical activity and intermediate values across the remaining lifestyle indicators, whereas a smaller profile showed a comparatively more favourable configuration, combining higher physical activity and Mediterranean diet adherence with lower screen time and sleep problems. Students in the latter profile reported lower levels of stress, anxiety, depression, and emotional exhaustion than those in the predominant profile. These findings support the value of examining health-related lifestyle behaviours jointly rather than considering each behaviour independently. However, the identified profiles were differentiated most clearly by physical activity, while differences in the remaining indicators were comparatively smaller. In addition, findings involving the small third profile should be regarded as exploratory. Differences in academic burnout were primarily observed for emotional exhaustion, whereas no significant overall differences were found for cynicism or academic efficacy.

Overall, the findings provide a descriptive account of how multiple health-related lifestyle behaviours co-occur within a large sample of fully online university students and how these configurations are associated with mental health and academic burnout. Given the cross-sectional and observational design, these associations should not be interpreted as causal or as evidence supporting specific intervention priorities. Nevertheless, the results may help inform future longitudinal and experimental research examining how different combinations of lifestyle behaviours relate to psychological and academic well-being in online university populations.

Abbreviations

ABIC: Sample-size adjusted Bayesian information criterion.
AIC: Akaike information criterion.
BCH: Bolck–Croon–Hagenaars.

BIC: Bayesian information criterion.
DASS-21: Depression Anxiety Stress Scales, 21-item version.
IPAQ-SF: International Physical Activity Questionnaire, short form.
LMR-LRT: Lo–Mendell–Rubin adjusted likelihood ratio test.
LPA: Latent profile analysis.
MBI-SS: Maslach Burnout Inventory, Student Survey.
MEDAS: Mediterranean Diet Adherence Screener.
MET: Metabolic equivalent of task.
PSQI: Pittsburgh Sleep Quality Index.
SD: Standard deviation.
SE: Standard error.

Declarations

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the Universidad Internacional de La Rioja in July 2023 (reference: PI031_2023) and was conducted in accordance with the Declaration of Helsinki. All participants provided informed consent through a mandatory online form before completing the questionnaire.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analysed during the current study are not publicly available due to ethical restrictions but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

RJB: Conceptualization, data curation, funding acquisition, investigation, supervision, and writing of the original draft. HGG: Formal analysis, investigation, supervision, and writing of the original draft. DAA:

Conceptualization, investigation, and writing of the original draft. JTC, JSS, LAK, MN, and JGP: Investigation and writing of the original draft.

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