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U-SMILE: a brief version of the Short Multidimensional Inventory on Lifestyle

Evaluation

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ABSTRACT

Introduction: Lifestyle Medicine comprises six domains: diet, substance use, physical activity, stress management, social connection, and sleep. The comprehensive assessment of lifestyle is challenging, but the “Short Multidimensional Inventory on Lifestyle Evaluation” (SMILE) was developed to fill out this gap. In this paper, we describe the development and the psychometric properties (internal consistency, concurrent and convergent validity) of a shorter version of the SMILE among university students.

Methods: Data from a cross-sectional study including 369 students from 10 Brazilian universities were used. Considering a theoretical nomological net, we performed exploratory factor analysis to obtain the most parsimonious, interpretable and good-fitting model.

Results: The final model was called U-SMILE, comprised 24 items, and presented acceptable internal consistency (Cronbach’s $\alpha = 0.73$, McDonald’s $\omega = 0.79$). To evaluate the concurrent validity of the U-SMILE, we compared it to the original SMILE and found a high correlation between the instruments (Spearman’s $r = 0.94$). Furthermore, we evaluated convergent validity by examining the U-SMILE correlation with the PHQ-9 (Spearman’s $r = -0.517$), and GAD-7 (Spearman’s $r = -0.356$), two validated instruments to screen for depression and anxiety, respectively.

Discussion: Our findings suggest that the U-SMILE is a valid instrument for assessing lifestyle among university students. We recommend that the use of U-SMILE to evaluate overall lifestyle scores rather than individual domain scores. Finally, we discuss the importance of clarifying the definitions of lifestyle and related constructs in future research.

Keywords: lifestyle, health questionnaires, validation, university students.

INTRODUCTION

Unhealthy lifestyle behaviors are major risk factors for morbidity and mortality worldwide^{1,2}. Those behaviors are unlikely to occur in isolation but instead tend to

cluster together among individuals³. Clusters with a higher number of unhealthier behaviors are associated with a reduced survival time without disability and higher mortality compared to these behaviors in isolation⁴⁻⁷.

In the last decades, Lifestyle Medicine (LM) emerged as a branch of evidence-based medicine to deliver strategies for changing unhealthy behaviors to prevent and treat chronic diseases, including mental health disorders⁸. The European Lifestyle Medicine Organization (ELMO) defined Lifestyle Medicine as *“an inter-disciplinary field of internal medicine, psychosocial and neurosciences, public and environmental health, and biology. Key LM principles include prevention strategies that address lifestyle habits, the underlying biological causes and the pathophysiology common to lifestyle-related diseases (e.g. low-grade systemic inflammation, dysregulated stress axis, metabolic dysfunctions, etc.)”*⁹.

The American College of Lifestyle Medicine (ACLM) proposes that the six main pillars of LM are diet, substance use, physical activity, stress management, social connection, and sleep¹⁰. Although the LM definition and the target areas for interventions have been discussed in the last years, the concept of “Lifestyle” is still under debate and may be hard to operationalize¹¹. As such, questionnaires assessing multiple lifestyle behaviors may consider different domains/dimensions. For instance, two widely used questionnaires for evaluating multiple lifestyle behaviors are the Fantastic lifestyle checklist¹² and the General Lifestyle Questionnaire¹³. The Fantastic lifestyle checklist assesses 9 domains, namely family and friends, physical activity, nutrition, tobacco and toxics, alcohol intake, sleep, seat belt use, stress, safe sex behavior patterns, insight, and career. On the other hand, the General Lifestyle Questionnaire evaluates five domains: physical, cognitive, social, and other leisure activities, sleep, food, tobacco and alcohol consumption. It is worth noting that the two questionnaires do not evaluate the same

lifestyle domains, and none of them follow exactly the same domains proposed by the ACLM and ELMO.

At the same time, there are numerous questionnaires available to measure a lifestyle domain isolated (i.e., questionnaires to evaluate alcohol use, or physical activity, or diet and others). However, to perform a comprehensive assessment of lifestyle by adopting multiple questionnaires may increase the burden for research participants and research costs. Furthermore, lifestyle behaviors are evaluated as independent risk factors and disregard the clustering and interconnection of behaviors^{14,15}. To overcome these barriers, the “**Short Multidimensional Inventory on Lifestyle Evaluation**” (SMILE), a 43-item questionnaire was developed to evaluate the six lifestyle domains proposed by the ACLM and, additionally, environmental exposures¹⁶. The development of the SMILE followed a multiple step process that included reviewing lifestyle questionnaires, expert’s feedback and revisions, and face validity as described elsewhere¹⁶. The hypothetical nomological network of the lifestyle construct, as well as the hypotheses surrounding convergent validity and factor structure of the SMILE are presented in **Figure 1**. It was expected that lifestyle domains presented correlations among each other due to the clustering of healthy/unhealthy behaviors. Furthermore, worse lifestyle scores should be associated with depression, anxiety and obesity (among other health outcomes).

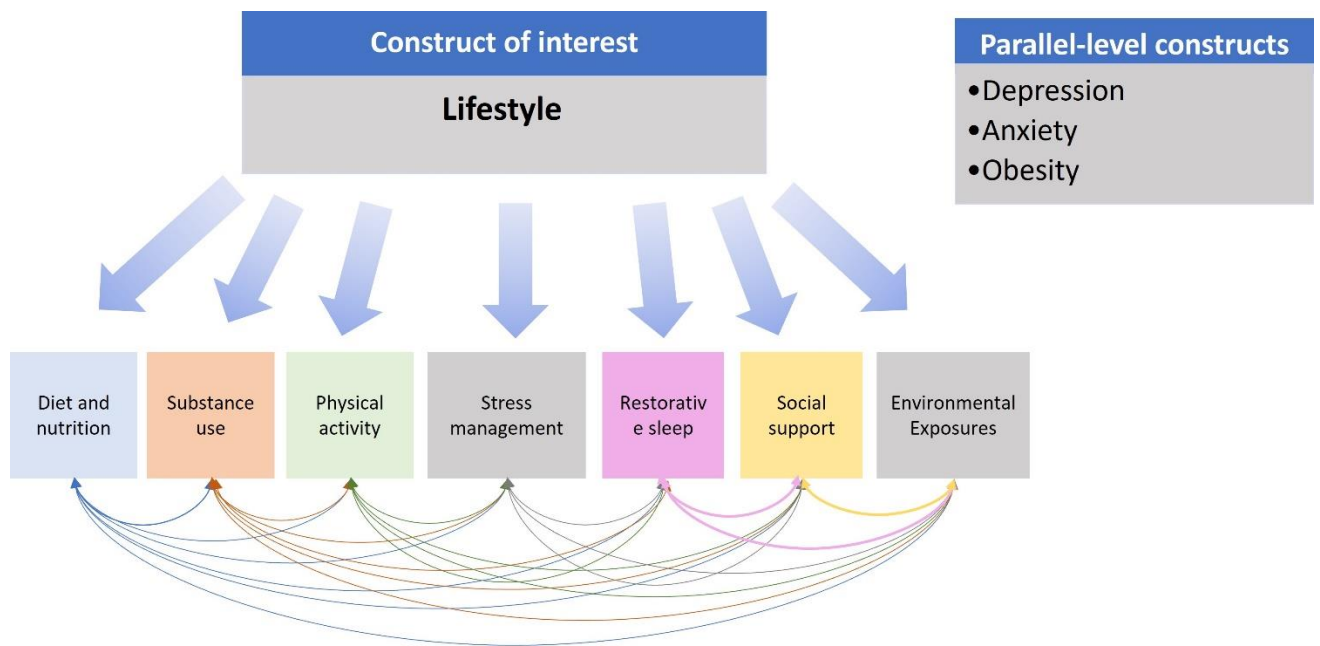


Figure 1: Hypothetical nomological network of the lifestyle construct.

In 2020, during the beginning of the COVID-19 pandemic, a shorter version of the SMILE was developed and had its initial psychometric characteristics evaluated^{16,17}. Such development was necessary due to the changes imposed by social distance and confinement essential to control virus' dissemination. In this process, some questions were dropped because they were not appropriate for the lockdown/confinement, resulting in the SMILE-C (SMILE for confinement) questionnaire. This shorter version comprised 27 items and presented good initial psychometric properties. However, almost three years later, individuals are reassuming their previous behaviors insofar in-person activities were restored in most of the countries.

This interplay between social isolation and lifestyle prompts us to pay attention to contexts in which lifestyle can be dynamic and influenced¹⁸. For example, university years impose shifts in social, academic, and financial demands to students^{19,20}, and adjustments to these new demands may impact their lifestyle²¹. It is well documented, for instance, that university students often present poor and unbalanced diet, high levels

of physical inactivity, and sedentary behavior, high rates of alcohol and other substance use, poor sleep quality, and high screen time²²⁻²⁵ Although these pieces of evidence demonstrate that university students present poor lifestyle behavior, the extant evidence relies on questionnaires that evaluate a single domain in isolation.

Therefore, considering that certain questions in the SMILE, which were deemed irrelevant in the context of the pandemic, may now hold relevance in the post-COVID society, and recognizing the necessity for a concise multidimensional lifestyle scale that specifically addresses the pertinent domains for university students, this paper endeavors to outline the development process of a short version of the **SMILE for university students**. Furthermore, it aims to present the initial psychometric properties of this scale (internal consistency, convergent and concurrent validity)

METHODS

Data from a cross-sectional study conducted in 10 Brazilian universities (covering 9 States and the five Brazilian macro-regions) were used. Data collection was conducted online using a questionnaire developed in REDCAP®. The assessments took place between May-December 2022.

Study Population

A convenience sample of students was recruited using online resources such as advertising on social media, the official university website, and direct emails. Newsletters and posters were fixed on the university walls with the link/QR code to the

study survey. Further face-to-face invitations through flyers distribution to students gathering places such as university restaurants, parks, and lectures.

Inclusion criteria were: 1) being 18-35 years old, and 3) having read and agreed to the consent form. Participants with missing data on the SMILE were excluded from the analysis, but not other exclusion criteria was adopted.

Sample size

A sample size above 300 individuals is considered large enough to conduct an exploratory factorial analysis, as revised by [Boateng et al \(2018\)](#)²⁶. In the present study 369 questionnaires were responded, thus reaching a suitable sample size for the aimed purpose.

Measures and assessments

The survey included questions on lifestyle, mental health symptoms, and demographics. Lifestyle was assessed using the Short Multidimensional Inventory Lifestyle Evaluation (SMILE). The questionnaire included the 43-item SMILE questionnaire, **which is self-reported and has been previously validated for online use**. Responses are provided through a four-item Likert scale (Always, Often, Seldom, Never) and scores are calculated by adding up all the answers. The higher the score, the better the lifestyle¹⁶.

Mental health problems were assessed at two levels. At the first level, the DSM-5 Level 1 Cross-Cutting Symptom Measure for Adults will be answered by all participants. The DSM-5 Level 1 Cross-Cutting Symptom Measure²⁷ is a self-reported questionnaire that assesses important domains across most psychiatric diagnoses. The adult version is composed of 23 questions that assess 13 psychiatric domains: depression, anger, mania,

anxiety, somatic symptoms, suicidal ideation, psychosis, sleep problems, memory problems, repetitive thoughts and behaviors, dissociation, personality functioning, and substance use. This is a 5-point Likert scale in which participants will respond "how much (or how often) you have been bothered by" a given problem during the past two weeks. Responses range from 0 = "None (not at all)" to 4 = "Severe (nearly every day)". Individuals presenting scores equal or greater than 2 for depression and anxiety symptoms, subsequently answered the Patient Health questionnaire (PHQ-9) and the Generalized Anxiety Disorder questionnaire (GAD-7). The PHQ-9²⁸ is a 9-item questionnaire for screening major depression. The scores range from 0 to 27, and scores ≥ 9 indicate a positive screening for depression. The PHQ-9 is widely used and was previously validated in Brazil²⁹. The GAD-7 is a 7-item questionnaire used for the screening of generalized anxiety disorder³⁰, validated in Brazil with cut-off ≥ 10 ³¹.

Sociodemographics included sex, age and Body Mass Index (BMI). BMI was measured through self-reported anthropometric measurements "What's your height? (cm)" and "What is your weight? (kg)". Subsequently, the body mass index (BMI) variable was calculated as body weight in kg divided by height in squared meters and categorized according to the World Health Organization criteria as: low weight / normal (≤ 24.9 kg/m²), overweight (25.0 -29.9 kg/m²) and obesity (over 30kg/m²).

Statistical Analysis

Initially, the specificity and redundancy of the 43 SMILE's items were evaluated among the authors because nonspecific items may affect the factor structure, and redundancy may affect convergent validity (25). Two Social Support's items were deemed to be non-specific (i.e., "Do you enjoy your leisure time", and "Are you satisfied with your sexual life"), and one item was considered redundant ("Do you take part in celebrations

/reunions with family/friends/colleagues”). Those items were excluded from subsequent analysis.

All the remaining 40 items were checked for normality using the Kolmogorov-Smirnov test (Supplementary Material 1). Due to non-normality, the correlation of items was evaluated through a polychoric matrix. Three items that did not present a ≥ 0.300 correlation with any other items were excluded (D-I1, E_I22, S_I27) - see **Supplementary Material 2**.

Afterwards, an Exploratory Factor Analysis (EFA) was performed including the 37 items. This first model was estimated without a priori specifications about the number of factors. Principal Axis Factoring was used for factor extraction, using the eigenvalues to determine the number of factors and Oblimin with Kaiser Normalization for matrix rotation. Items were then eliminated if: 1) presented loading < 0.30 in all factors, 2) presented cross-loading with similar magnitude in 2 or more factors; and 3) presented higher load in factors different than defined in the hypothesized nomological net (Figure 1). Model fit was evaluated through the *Root Mean Square Error of Approximation* (RMSEA), and *Tucker-Lewis Index* (TLI). RMSEA values lower than 0.08, and TLI values above 0.90 were considered acceptable. The solution was critically evaluated within the context of the questionnaire hypothesized structured (**Figure 1**). This process was repeated until the most parsimonious, interpretable, and good-fitting solution was obtained (called U-SMILE).

Internal consistency was evaluated using Cronbach's α (which was considered acceptable if ≥ 0.70) and McDonald's ω (acceptable if > 0.60). The criterion validity and construct validity were evaluated through concurrent validity and convergent validity, respectively (26). Concurrent validity (i.e., comparison with the reference standard)

was evaluated by analyzing the correlation of the U-SMILE with the SMILE. **The Spearman's rank correlation coefficient was used because data did not show normal distribution in the Kolmogorov–Smirnov tests.** Convergent validity (comparison with other measure that is a related, but a different construct) was evaluated by analyzing the correlation of the U-SMILE with PHQ-9, GAD-7 and BMI (Spearman's rank correlation coefficient).

Finally, the mean U-SMILE scores were compared between individuals with/without positive screenings for depression and anxiety, and with low/normal BMI vs. obesity.

The comparisons were tested using the Mann Whitney's test at significance level of 5.0% because data did not show normal distribution in the Kolmogorov–Smirnov tests.

All the analyses were conducted in SPSS 20.0 and open-source software R 4.3.2.

Ethical Issues

The study was approved by all participating ethics committee study sites under register # 55481422.5.1001.5346. All participants read and consent to participate in the study.

RESULTS

A total of 369 students filled in the SMILE (58.5% women) and were included in the present analysis. Of those, 34.7% presented a positive screening for depression (PHQ-9 ≥ 9), 42.8% presented a positive screening for anxiety (GAD-7 ≥ 10), and 9% presented BMI higher than 30.

In the first EFA model, we found an eleven-factor solution - Table 1. This model was interpreted following the nomological net. Factor 1 was considered to be measuring a different construct, i.e., well-being, and the items E_I20, E_I23, E_I24 and SS_I36 were

dropped. Item E_I19 (Practice a faith or religion) was kept because it may be considered a strategy to deal with stress. Additionally, item AF_I14 was dropped because did not present a load higher than 0.3 in any factor.

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**Table 1- Results from the exploratory factorial analysis for reaching the first solution for reducing the SMILE (n=369).
Brazil. 2022**

Domain	Item	Factor										
		1	2	3	4	5	6	7	8	9	10	11
Diet	D_I2 Check labels	-.053	.056	-.075	-.008	-.008	.190	-.001	-.065	.169	-.011	-.451
	D_I3 Eat processed food	-.124	.097	-.094	-.001	.031	-.032	-.921	-.067	-.090	.044	.076
	D_I4 Eat fast-food when sad	.028	.080	.113	-.126	-.044	.182	-.362	.049	.058	.037	-.033
	D_I5 Eat healthy foods	-.004	.030	-.097	.041	-.113	.034	-.015	-.244	.078	-.017	-.454
	D_I6 Keep meal schedule	.128	-.035	.259	.106	-.364	.008	-.115	.127	.041	.226	-.382
	D_I7 Share main meals	.058	-.037	-.007	.051	-.155	.097	.008	-.144	-.096	.511	.066
Substance Use	S_I8 Binge drinking	.116	.541	.215	-.130	.076	.126	-.053	.131	-.017	.090	-.113
	S_I9 Tobacco smoking	-.002	.771	-.001	-.088	-.048	-.041	.006	-.093	-.049	-.067	-.131
	S_I10 Cannabis use	-.038	.878	-.031	.010	-.058	.024	.047	.006	-.021	-.011	.090
	S_I11 Other drug use	.005	.617	-.115	.164	.054	-.114	-.140	.019	.016	.030	.065
Physical Activity	AF_I12 Exercise 30 min/day	.006	-.068	-.048	.019	-.039	-.111	.007	.023	.657	-.028	-.221
	AF_I13 Play 2h team sports	.018	-.108	.000	-.119	.014	-.003	.033	-.048	.524	.133	.092
	AF_I14 Choose climb stairs	.135	-.067	.117	-.035	-.081	.003	-.257	-.076	.141	-.085	-.038
	AF_I15 Feel good exercising	.234	.038	-.036	-.094	.070	-.063	-.133	-.052	.480	-.093	-.083
Stress Management	E_I16 Make time to relax	.039	.037	.033	.108	-.416	.034	-.063	-.033	.337	.109	.196
	E_I17 Use Cog/psy strategies	.047	.003	-.049	.475	-.119	.051	.026	-.063	.052	-.038	-.082
	E_I18 Use physical strategies	-.068	.008	-.023	.289	-.013	.120	-.007	-.082	.670	-.011	-.110
	E_I19 Practice a faith/religion	.395	.157	.174	.085	-.015	.075	.164	-.032	-.045	.154	.054
	E_I20 Feel good work-life balan	.437	-.076	.048	-.091	-.183	-.117	-.083	-.082	.084	.010	-.098
	E_I21 Feel work never ends	.050	.034	-.090	-.416	-.262	.167	-.047	-.082	.086	-.077	.136
	E_I23 Feel life has meaning	.728	-.013	-.107	-.091	-.058	-.014	.018	-.028	.018	-.030	.010
	E_I24 Feel grateful for the life	.714	.013	-.162	-.015	-.005	.004	-.032	-.102	.023	.027	.040
Sleep	S_I25 Sleep 7-9h/day	-.046	-.006	-.052	-.010	-.789	-.047	.053	-.034	-.074	.042	.006

	S_I26 Feel rested after sleep	.132	-.029	-.088	-.108	-.539	-.010	-.051	-.137	.029	.002	.061
	S_I28 Maintain sleep schedule	.056	.032	.031	.038	-.705	.012	-.057	.053	-.034	.001	-.199
	S_I29 Use sleeping pills	.096	-.019	-.014	-.565	-.049	.009	-.067	.050	-.028	.074	-.135
Social	SS_I30 Interact with friend/fam	.026	.028	-.184	.049	-.104	.003	-.013	-.056	.052	.555	.065
	SS_I31 Belonging	.263	-.112	-.121	.024	.012	-.075	-.058	-.074	.129	.404	.005
	SS_I32 Has someone to trust	.166	.038	-.594	.000	-.104	.046	-.003	-.034	-.025	.152	-.178
	SS_I33 Someone helps chores	-.033	.061	.015	-.118	.033	-.105	-.010	-.038	-.002	.531	-.077
	SS_I34 Has someone to go out	.102	-.042	-.488	.022	-.019	-.068	-.008	.052	.157	.408	.023
	SS_I35 Make yourself available	.163	-.062	-.146	-.157	-.007	.041	.029	-.168	.163	.312	.029
	SS_I36 Feel loved	.338	.047	-.396	.040	-.013	.019	-.069	.038	.065	.238	-.093
Environ mental Exposure	A_I37 More 2h watching TV	.016	-.111	-.047	.157	.073	.385	-.168	.032	-.205	-.014	-.099
	A_I38 Cel phone before sleep	-.032	-.009	.003	-.080	.012	.746	.032	-.064	.058	-.054	-.018
	A_I39 In touch with nature	-.106	.028	-.015	.030	-.101	.025	-.018	-.633	.081	.113	.022
	A_I40 Feel nature is part of you	.142	-.019	.080	.049	.109	.013	-.041	-.802	-.088	.023	-.103

Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization. Loads with the same color were in the same factor.

Subsequent models were performed including the remaining 32 items until reaching the most parsimonious model that presented acceptable goodness-of-fit and internal consistency - **Table 2**. The final model (**Supplementary Material 3**) comprised an eight-factor scale with 24 items. The U-SMILE versions in English, Portuguese and Spanish are presented in **Supplementary Material 4**.

Table 2: Results from the final exploratory factorial analysis - U-SMILE (n=369). Brazil. 2022

Domain	Item		Factor							
			1	2	3	4	5	6	7	8
Diet	D_I2	Check labels	.007	.060	.202	-.001	.257	.001	.006	-.455
	D_I3	Eat processed food	.081	.238	.364	-.068	.093	-.049	-.358	.158
	D_I5	Eat healthy foods	.037	.068	.074	-.077	.206	-.154	-.019	-.415
Substance Use	S_I8	Binge drinking	-.049	.550	.218	.004	.067	.157	.327	.040
	S_I9	Tobacco smoking	-.117	.772	-.045	-.072	.018	-.061	.066	-.071
	S_I10	Cannabis use	-.045	.822	-.114	-.024	-.085	-.015	.071	.010
	S_I11	Other drug use	.149	.671	-.095	.092	-.060	-.018	-.160	.006
Physical Activity	AF_I12	Exercise 30 min/day	.030	-.083	-.142	-.086	.679	.051	-.079	-.164
	AF_I13	Play 2h team sports	.106	-.135	-.117	-.016	.444	-.108	.040	.098
	AF_I15	Feel good exercising	.053	.055	.036	-.023	.603	-.065	-.014	.046
Stress Management	E_I17	Use Cognitive/psychological strategies	.054	-.023	-.017	-.043	-.111	-.080	.005	-.318
	E_I19	Practice a faith or religion	.139	.126	.007	-.052	-.037	-.063	.515	.032
Restorative Sleep	S_I25	Sleep 7-9h/day	-.022	-.039	-.086	-.932	-.096	.030	-.007	.035
	S_I26	Feel rested after sleep	.094	-.028	.033	-.588	.081	-.115	-.017	.094
	S_I28	Maintain sleep schedule	.011	.049	.072	-.639	.058	.063	.022	-.137
Social Support	SS_I30	Interact with friends/Family	.620	.051	-.044	-.100	-.093	-.062	.087	.029
	SS_I31	Belonging	.543	-.062	-.001	-.057	.114	-.082	.112	.055
	SS_I32	Has someone to trust	.619	.033	.047	-.035	-.010	.022	-.071	-.232
	SS_I34	Has someone to go out	.773	-.036	-.059	.013	.049	.056	-.052	-.022
	SS_I35	Make yourself available	.475	-.060	.050	-.025	.191	-.141	.155	.116
Environmental Exposure	A_I37	More than 2h watching TV	.022	-.102	.548	.031	-.161	.029	-.063	-.061
	A_I38	Use cell phone before sleep	-.099	-.075	.493	-.049	.015	-.104	.102	-.066
	A_I39	In touch with nature	.004	.029	-.064	-.074	.003	-.722	-.087	-.035
	A_I40	Feel nature is part of you	.010	.006	.113	.060	.013	-.728	.105	-.070

Note: Model fit: RMSEA=0.034. TLI=0.945. BIC= -499.7. Loads with the same color were in the same factor.

The U-SMILE presented acceptable internal consistency (Cronbach's $\alpha = 0.73$.

McDonald's $\omega = 0.79$), as well as evidence of concurrent validity (high correlation with the original SMILE), and convergent validity (moderate correlation with PHQ-9 and GAD-7) – please, see Table 3.

Table 3 - Internal consistency, concurrent validity and convergent validity of the SMILE¹ Solution 1 and the U-SMILE

	SMILE ORIGINAL¹ 40 items	U-SMILE 24 items
Internal Consistency		
Cronbach's α	0.86	0.73
McDonald's ω	0.87	0.79
Concurrent Validity		
Spearman's r with SMILE ¹	1	0.94*
Spearman's r with PHQ-9	-0.553*	-0.517*
Spearman's r with GAD-7	-0.408*	-0.356*
Spearman's r with BMI	-0.033	-0.032

¹Original SMILE without non-specific and redundant items. * $p_{\text{value}} < 0.05$

Descriptive statistics of the U-SMILE by sex, age, depression, anxiety, and BMI are presented in Table 4. Individuals without depression or anxiety presented a better lifestyle (i.e. higher U-SMILE scores) as compared with individuals presenting depression and anxiety, respectively. Lifestyle score was better among individuals with low/normal weight as compared with those with obesity; but the difference was not statistically significant.

Table 4: U-SMILE⁽¹⁾ scores by selected sample characteristics (n= 369). Brazil, 2022

	Variables	n (%)	Mean (SD)	Median (IRQ)	p-value⁽²⁾
Sex	Women	217 (58.8)	67.1 (8.2)	68.0 (11.0)	0.256
	Men	152 (41.2)	68.3 (8.1)	69.0 (10.0)	
Age	Up to 21 years	223 (60.4)	67.7 (8.5)	69.0 (10.0)	0.638
	21 +	140 (37.9)	67.4 (7.7)	68.0 (11.0)	
PHQ-9 ⁽³⁾	Negative	201 (54.5)	70.8 (6.9)	71.0 (9.0)	<0.001
	Positive	128 (34.7)	63.4 (8.0)	63.5 (12.0)	

GAD-7 ⁽³⁾	Negative	171 (46.3)	68.9 (7.4)	69.0 (9.0)	<0.001
	Positive	158 (42.8)	63.9 (8.0)	64.0 (13.0)	
BMI ⁽⁴⁾	Normal	263 (71.3)	67.7 (8.1)	69.0 (10.0)	0.487
	Obesity	34 (9.2)	68.0 (7.8)	68.0 (11.0)	

Notes: ⁽¹⁾ The higher the score, the better the lifestyle; ⁽²⁾ p_value independent samples Mann-Whitney test; ⁽³⁾ Cutoff positive ≥ 10 ; ⁽⁴⁾ World Health Organization criteria

DISCUSSION

In this paper, we presented the shorter version of the SMILE, aimed to evaluate lifestyle among university students, the U-SMILE. The U-SMILE comprised 24 items and had acceptable internal consistency, as well as evidence of convergent and concurrent validity. Improving lifestyle has been shown effective for primary, secondary and tertiary prevention of mental health disorders ^{14,32–34}. Therefore, the correlation between the U-SMILE and the mental health scores was expected and provides evidence of convergent validity. **Additionally, our study showed a moderate correlation between lifestyle and mental health measures, and the lack of a strong correlation between these measures indicates** that it is unlikely the U-SMILE to be a surrogate measure of depression and/or anxiety (i.e. the U-SMILE is measuring a different construct).

It was expected that U-SMILE score to be correlated with BMI because unhealthy diet and physical inactivity are the major drivers of overweight/obesity³⁵. **In a previous study conducted in Brazil and Spain³⁶, we** have shown that the SMILE-C scores were lower among obese individuals (compared to those with normal BMI), but we did not find an association with overweight. Herein, we did find that individuals with normal BMI presented better lifestyle scores than those with obesity, but the difference was not statistically significant at 5%. It is possible that the small sample size (regarding the number of obese individuals) has limited the statistical power to detect an association between obesity and the U-SMILE among university students. It is also possible that individuals with higher BMI are trying to change their lifestyle (i.e., adopting a

healthier diet and/or exercising, decreasing sedentary behavior) to lose weight, and longitudinal studies will be necessary to disentangle reverse causality³⁷.

To reach the U-SMILE, we used a theory-driven approach where the statistical solutions were interpreted following a hypothetical nomological network. In our hypothesis, the lifestyle construct presented seven domains that were correlated with each other. However, our best solution was an eight-factor scale where some items loaded on different factors than expected, e.g., eating processed food loading in the same factor of screen time. There is evidence that high screen time increases the odds of eating processed/unhealthy food in youth^{38, 39}, and these behaviors may be correlated (at least moderately)⁴⁰. On the contrary, we expected that screen time and contact with nature were in the same factor, given that the increase in screen time parallels a reduction in time spent in natural environments in recent times⁴¹. However, such hypothesis was not confirmed. For these reasons, we recommend the U-SMILE is not used for evaluating domains isolatedly, instead, researchers should consider the overall scores as the main index following the assumption that lifestyle is a single, multidimensional construct.

During the analytical process, we also found that some of the original items were reflecting a different construct. The items in the first model's Factor 1 (i.e., "you feel...good work-life balance", "... feel life has a meaning?", "... feel grateful", and "...feel loved") are likely to be related with well-being instead of lifestyle. It is important to note that the definitions of both, lifestyle and well-being, are matters of controversy and not at all research instruments make it clear the rational/theoretical definitions that underlie item creation/selection. For instance, Linton et al.⁴² found 99 questionnaires for measuring well-being, and many of them included items on alcohol use, social support and physical activity (understood here as lifestyle behaviors). Despite the lack of consensus on the definition of well-being, it can be described as "a

state of positive feelings and meeting full potential in the world”⁴³. For instance, “Feeling loved” is one item of the Warwick Edinburgh Mental Well-being Scale, one of the most used questionnaires for measuring well-being^{44,45}. There is evidence that well-being is associated with healthy behaviors, mental and physical health^{46,47}. We found that the exclusion of the “well-being” items resulted in the subsequent exclusion of another item that could be reflecting mental well-being or emotional eating behavior (“... eat fast-food when you are stressed or sad?”).

This study is not free of limitations. First, as any other self-responded survey, social desirability bias may not be excluded, but it has been suggested that anonymous online questionnaires may be an efficient strategy to reduce it⁴⁸. Second, web surveys are prone to selection bias, and it is possible that individuals interested in lifestyle and mental health are more prone to participate – and the error introduced by this bias remains to be addressed in studies profiting from probability samples⁴⁹. Third, the U-SMILE was developed and validated considering the present definition of lifestyle- and future developments in the field may yield the need for revisions.

Despite these limitations, this paper is based in findings from 10 Brazilian universities from different states/regions and shows the major decisions taken to reach this reduced version of the SMILE. Exploratory factor analysis is a complex, interactive, process that has not always been reported in a reproducible manner⁵⁰. Although there are efforts to improve transparency^{51–53}, researchers still need to take many decisions that are impossible to publish in scientific papers. Beavers et al. (2019)⁵³ emphasize the importance of theoretical knowledge and common sense to reach the most “parsimonious, mathematically sound, and theoretically grounded” solution. We add that, among the multiple mathematically sound possible solution, authors should make clear in which way the theory drove the process to reach the final solution.

Finally, we believe that the U-SMILE helps to fill out a gap in improving the measurement of lifestyle, in general, and among university students, which must be an overarching goal for clinical and epidemiological research.

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Supplementary Material 1 - normality check

Dimensão	Item	Normalidade
Dieta e nutrição	D_I1	W = 0.76714. p-value < 2.2e-16
	D_I2	W = 0.79511. p-value < 2.2e-16
	D_I3	W = 0.79032. p-value < 2.2e-16
	D_I4	W = 0.86333. p-value < 2.2e-16
	D_I5	W = 0.83844. p-value < 2.2e-16
	D_I6	W = 0.86555. p-value < 2.2e-16
	D_I7	W = 0.86671. p-value < 2.2e-16
Substância	S_I8	W = 0.77855. p-value < 2.2e-16
	S_I9	W = 0.48816. p-value < 2.2e-16
	S_I10	W = 0.44103. p-value < 2.2e-16
	S_I11	W = 0.1617. p-value < 2.2e-16
Atividade física	AF_I12	W = 0.83066. p-value < 2.2e-16
	AF_I13	W = 0.77501. p-value < 2.2e-16
	AF_I14	W = 0.87736. p-value < 2.2e-16
	AF_I15	W = 0.61632. p-value < 2.2e-16
Manejo estresse	E_I16	W = 0.86326. p-value < 2.2e-16
	E_I17	W = 0.74878. p-value < 2.2e-16
	E_I18	W = 0.83673. p-value < 2.2e-16
	E_I19	W = 0.83042. p-value < 2.2e-16
	E_I20	W = 0.87288. p-value < 2.2e-16
	E_I21	W = 0.85616. p-value < 2.2e-16
	E_I22	W = 0.8663. p-value < 2.2e-16
	E_I23	W = 0.85026. p-value < 2.2e-16
E_I24	W = 0.79149. p-value < 2.2e-16	
Sono	S_I25	W = 0.87226. p-value < 2.2e-16
	S_I26	W = 0.87204. p-value < 2.2e-16
	S_I27	W = 0.83846. p-value < 2.2e-16
	S_I28	W = 0.45836. p-value < 2.2e-16
	S_I29	W = 0.76071. p-value < 2.2e-16
Suporte social	SS_I30	W = 0.849. p-value < 2.2e-16
	SS_I31	W = 0.82161. p-value < 2.2e-16
	SS_I32	W = 0.80604. p-value < 2.2e-16
	SS_I33	W = 0.81666. p-value < 2.2e-16
	SS_I34	W = 0.83188. p-value < 2.2e-16
	SS_I35	W = 0.78636. p-value < 2.2e-16
	SS_I36	W = 0.83692. p-value < 2.2e-16
Ambiente	A_I37	W = 0.64923. p-value < 2.2e-16
	A_I38	W = 0.85397. p-value < 2.2e-16
	A_I39	W = 0.83136. p-value < 2.2e-16
	A_I40	W = 0.81666. p-value < 2.2e-16

Supplementary material 2. Correlation matrix among the items

Please, see. xls spreadsheet

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Supplementary material 3**Table S1. Total variance explained**

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings ^a
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.566	19.023	19.023	4.065	16.937	16.937	2.990
2	2.676	11.150	30.173	2.250	9.376	26.313	2.201
3	1.893	7.887	38.060	1.302	5.427	31.740	1.024
4	1.463	6.096	44.156	1.001	4.172	35.912	2.592
5	1.379	5.747	49.903	0.891	3.711	39.623	1.950
6	1.226	5.109	55.012	0.674	2.808	42.431	2.262
7	1.136	4.731	59.744	0.534	2.225	44.656	0.700
8	1.060	4.417	64.161	0.455	1.896	46.552	0.989
9	0.913	3.803	67.964				
10	0.818	3.407	71.370				
11	0.697	2.903	74.274				
12	0.680	2.832	77.105				
13	0.635	2.648	79.753				
14	0.609	2.536	82.289				
15	0.568	2.368	84.657				
16	0.535	2.229	86.886				
17	0.484	2.017	88.903				
18	0.465	1.939	90.842				
19	0.464	1.935	92.777				
20	0.392	1.634	94.412				
21	0.380	1.582	95.993				
22	0.340	1.417	97.410				
23	0.334	1.392	98.802				
24	0.288	1.198	100.000				

Extraction Method: Principal Axis Factoring.

a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table S2: KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.778
Bartlett's Test of Sphericity	Approx. Chi-Square	2346.002
	df	276
	Sig.	0.000

Table S3: Communalities matrix

Items	Initial	Extraction
D_I2C	0.257	0.369
D_I3	0.184	0.369
D_I5C	0.288	0.364
S_I8	0.384	0.518
S_I9	0.508	0.615
S_I10	0.562	0.695
S_I11	0.416	0.486
AF_I12C	0.360	0.559
AF_I13C	0.281	0.325
AF_I15C	0.310	0.422
E_I17C	0.117	0.136
E_I19C	0.202	0.341
S_I25C	0.485	0.786
S_I26C	0.438	0.484
S_I28C	0.409	0.485
SS_I30C	0.405	0.467
SS_I31C	0.402	0.439
SS_I32C	0.377	0.468
SS_I34C	0.464	0.598
SS_I35C	0.378	0.443
A_I37	0.220	0.336
A_I38	0.223	0.308
A_I39C	0.399	0.565
A_I40C	0.415	0.594

Extraction Method: Principal Axis Factoring.

Table S4: Factor Correlation Matrix.

Factor	1	2	3	4	5	6	7	8
1	1.000	-0.028	0.079	0.370	0.295	0.399	0.028	0.073
2	0.028	1.000	0.106	0.049	0.033	0.033	0.061	0.028
3	0.079	0.106	1.000	0.080	0.037	0.113	0.040	0.191
4	0.370	0.049	0.080	1.000	0.247	0.348	0.090	0.200
5	0.295	0.033	0.037	0.247	1.000	0.249	0.011	0.051
6	0.399	0.033	0.113	0.348	0.249	1.000	0.091	0.210
7	0.028	0.061	0.040	0.090	0.011	0.091	1.000	0.003
8	0.073	0.028	0.191	0.200	0.051	0.210	0.003	1.000

Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization.

Supplementary Material 4**English version:****U-SMILE: University Short Multidimensional Inventory Lifestyle Evaluation**

<i>In the last month, how often in your daily routine...</i>		Always	Often	Seldom	Never
Diet and nutrition	1. When shopping for food, do you check labels for ingredients such as quantity of salt?	4	3	2	1
	2. Do you eat processed food (frozen food such as pizza, French fries, puff pastries, deep-fried foods and canned foods)?	1	2	3	4
	3. Do you eat healthy foods such as fresh fruits, fresh vegetables, wholegrain, legumes or nuts?	4	3	2	1
Substance use	4. Do you drink 5 or more doses (men) or 4 or more doses (women) of alcoholic beverages on a single occasion, which means within 2 hours? (1 dose of alcohol=1 glass of beer OR 1 glass of wine OR 1 shot of spirit (such as rum, vodka, whisky, tequila or gin)).	1	2	3	4
	5. Do you smoke tobacco (cigarette, electronic cigarette, cigar, pipe, smokeless tobacco)?	1	2	3	4
	6. Do you use marijuana or hashish?	1	2	3	4
	7. Do you use other drugs (cocaine, crack, amphetamines, ecstasy, opioids without medical prescription, and others)?	1	2	3	4
Physical activity	8. Do you exercise for at least 30 minutes daily (or 150 minutes a week)?	4	3	2	1
	9. Do you play at least 2 hours of team sports (like soccer, volleyball, basketball, rugby, etc.) a week?	4	3	2	1
	10. Do you feel good after performing physical activity?	4	3	2	1
Stress management	11. Do you use any strategy or psychological support to deal with stress (for instance meditation, mindfulness or psychotherapy)?	4	3	2	1
	12. Do you practice a faith or religion?	4	3	2	1
Sleep	13. Do you manage to sleep between 7 and 9 hours per night?	4	3	2	1
	14. Do you feel rested with the number of hours you sleep?	4	3	2	1
	15. Do you maintain a regular sleep schedule?	4	3	2	1
Social support	16. Do you interact with your friends and/or relatives?	4	3	2	1
	17. Do you feel that you are part of a group of friends, the community or the society?	4	3	2	1
	18. Do you have someone you trust who listens to your problems or concerns?	4	3	2	1
	19. Do you have someone in your life to go out or have fun with when you feel like it?	4	3	2	1
	20. Do you make yourself available to support your significant ones?	4	3	2	1
Environment exposures	21. Do you spend more than 2 hours a day watching TV, playing computer games, video games or on the internet?	1	2	3	4
	22. Do you spend time on a computer / smartphone within one hour of going to sleep?	1	2	3	4
	23. Are you in touch with nature (for instance parks, beach, countryside, mountains)?	4	3	2	1
	24. Do you feel your relationship to nature, that is all living things, is an important part of who you are?	4	3	2	1

The score is provided by summing up all the answers.

Versão em Português:**U-SMILE: Breve inventário para avaliação multidimensional do estilo de vida de universitários**

No último mês, com que frequência na sua rotina diária, você...		Sem pre	Frequente mente	Eventual mente	Nunca
Dieta e Nutrição	1. Ao comprar comida, verificou os rótulos quanto a ingredientes, como quantidade de sal?	4	3	2	1
	2. Consumiu alimentos pré-prontos (congelados tais como pizza, batata-frita, empanados em geral e enlatados)?	1	2	3	4
	3. Comeu alimentos saudáveis, tais como frutas e vegetais frescos, legumes, produtos integrais ou amendoim, nozes, castanhas, etc.?	4	3	2	1
Uso de substâncias	4. Bebeu 5 ou mais doses de bebidas alcoólicas* (homem) ou 4 ou mais doses (mulher) em uma única ocasião, ou seja, em cerca de 2hs?	1	2	3	4
	5. Utilizou derivados do tabaco (cigarro, cigarro eletrônico, charuto, cachimbo, fumo de corda)?	1	2	3	4
	6. Utilizou maconha, Skank, haxixe?	1	2	3	4
	7. Utilizou outras drogas ilícitas (cocaína, crack, anfetaminas, ecstasy, opioides sem prescrição médica, etc.)?	1	2	3	4
Atividade Física	8. Se exercitou pelo menos 30 minutos/dia (ou 150 minutos por semana)?	4	3	2	1
	9. Praticou pelo menos 2 horas de esporte coletivo (futebol, voleibol, basquete) por semana?	4	3	2	1
	10. Sentiu-se bem após realizar atividade física?	4	3	2	1
Gerenciar stress	11. Usou de estratégias cognitivas OU suporte psicológico para lidar com o estresse (por exemplo: meditação, mindfulness e psicoterapia)?	4	3	2	1
	12. Praticou uma crença, religião ou espiritualidade?	4	3	2	1
Sono	13. Dormiu entre 7 e 9 horas por dia?	4	3	2	1
	14. Sentiu-se descansado(a) com o número de horas dormidas?	4	3	2	1
	15. Manteve a regularidade em relação aos horários de sono?	4	3	2	1
Suporte Social	16. Interagiu com seus amigos e/ou familiares?	4	3	2	1
	17. Teve a sensação de pertencimento OU sentiu-se incluído (sentiu que faz parte de um grupo de amigos, de uma comunidade, da sociedade)?	4	3	2	1
	18. Teve alguém de confiança para escutar seus problemas/preocupações?	4	3	2	1
	19. Teve companhia para sair/disfrutar OU curtir/divertir quando necessitou?	4	3	2	1
	20. Esteve disponível para pessoas importantes para você?	4	3	2	1
Ambiente	21. Gastou mais de 2 horas por dia assistindo TV, jogando jogos de computador, videogames ou navegando na internet ?	1	2	3	4
	22. Ficou no computador ou smartphone na hora imediatamente anterior a ir dormir ?	1	2	3	4
	23. Esteve em contato com a natureza (parques, praia, campo, montanha) ?	4	3	2	1
	24. Sentiu que seu relacionamento com a natureza, com todas as coisas vivas, é uma parte importante de quem você é ?	4	3	2	1

O escore da U-SMILE é calculado pela soma de todas as respostas.

Versión en español**U-SMILE: Breve inventario para la evaluación multidimensional del estilo de vida de los universitarios**

En su rutina diaria durante el último mes, ¿con qué frecuencia usted... ?		Sempre	Con frecuencia	A veces	Nunca
Dieta y Nutrición	1. Cuando ha hecho la compra, se ha fijado en las etiquetas de ingredientes de los alimentos, como la cantidad de sal	4	3	2	1
	2. Ha comido alimentos procesados, es decir, congelados como pizzas, patatas fritas, bollería industrial, fritos y comida enlatada	1	2	3	4
	3. Ha comido alimentos saludables como frutas frescas, verduras frescas, cereales integrales, legumbres o frutos secos	4	3	2	1
Consumo de sustancias	4. Ha bebido 5 o más dosis (si es hombre) o 4 o más dosis (si es mujer) de bebidas alcohólicas* en una sola ocasión, es decir, en menos de 2 horas	1	2	3	4
	5. Ha fumado tabaco (cigarrillos, cigarrillo electrónico, puro, pipa, tabaco sin humo)	1	2	3	4
	6. Ha fumado marihuana o hachís	1	2	3	4
	7. Ha tomado otras drogas (cocaína, crack, anfetaminas, éxtasis, opiáceos sin receta médica u otras drogas)	1	2	3	4
Actividad física	8. Ha realizado ejercicio físico al menos 30 minutos cada día (o 150 minutos a la semana)	4	3	2	1
	9. Ha hecho deporte de equipo (fútbol, voleibol, baloncesto, rugby...) al menos 2 horas a la semana	4	3	2	1
	10. Se ha sentido bien después de hacer actividades físicas	4	3	2	1
Manejar el estrés	11. Ha usado alguna estrategia o apoyo de tipo psicológico para manejar el estrés. Por ejemplo, meditación, mindfulness o psicoterapia	4	3	2	1
	12. Ha practicado alguna religión o creencia espiritual	4	3	2	1
Dormir	13. Ha logrado dormir entre 7 y 9 horas cada noche	4	3	2	1
	14. Ha sentido que ha descansado con el número de horas que duerme	4	3	2	1
	15. Ha mantenido un horario de sueño regular	4	3	2	1
Apoyo social	16. Ha interactuado con sus amigos y/o familiares	4	3	2	1
	17. Ha sentido que forma parte de un grupo de amigos, de su comunidad o de la sociedad	4	3	2	1
	18. Ha tenido alguien de su confianza disponible que escuche sus problemas o preocupaciones	4	3	2	1
	19. Ha tenido a alguien en su vida con quien salir o divertirse cuando le apetece	4	3	2	1
	20. Ha estado disponible para ayudar a sus seres queridos	4	3	2	1
Ambiente	21. Ha pasado más de 2 horas al día viendo la televisión, jugando en el ordenador, videojuegos o en internet	1	2	3	4
	22. Ha usado el ordenador o el móvil una hora antes de acostarse	1	2	3	4
	23. Ha dedicado tiempo a estar en contacto con la naturaleza, por ejemplo en parques, la playa, el campo o la montaña	4	3	2	1
	24. Ha sentido que su relación con la naturaleza, es decir todos los seres vivos, es una parte importante de quién es usted	4	3	2	1

La puntuación de U-SMILE se calcula sumando todas las respuestas.