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Examining the neighborhood environment walkability scale in a sample of college students: Psychometric testing and predictive analysis

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ABSTRACT

Background: Despite the known benefits of physical activity (PA), physical inactivity levels have grown over the last years. Since most individuals in developed countries rely on their private cars for transportation, the promotion of active modes of transport, such as walking or cycling, is a possible and viable strategy to encourage active living among workers and students. Evidence supports the important role of the built environment in the modulation of PA and active commuting patterns. However, the role of the built environment in quality of life is less clear.
Methods: The main purpose of the present study is to adapt and validate the NEWS-A, one of the most popular measures of perceived neighborhood environment, in a sample of Portuguese college students (NEWS-A-PT). A CFA was conducted, in order to examine the factorial structure of the mentioned instrument. This study also aims to explore how perceived neighborhood environment characteristics relate to PA and quality of life.
Results: In general, the NEWS-A-PT displayed acceptable levels of temporal reliability, and the revised 32-item model provided acceptable fit to the data. Additionally, significant correlations were found between NEWS-A-PT factors and indicators of PA and quality of life.
Conclusions: The present study provides empirical support for the validity and reliability of the six-factor and 32-item version of the NEWS-A-PT for Portuguese college students. It also supports the assumption that perceived neighborhood environment characteristics are associated with both PA and quality of life.

1. Background

Evidence points that regular physical activity (PA) has multiple benefits, being associated with a decreased risk of all-cause mortality, cancer mortality, and several chronic conditions, such as cardiovascular disease, type II diabetes, high blood pressure, breast cancer, colon cancer, gestational diabetes, gallstone disease, ischemic heart disease, and ischemic stroke (Warburton and Bredin, 2017). However, regardless all the known benefits of PA, with the acquisition of new transportation behaviors, increased use of technology and increased urbanization, physical inactivity levels have grown over the last years in developed countries, reaching rates as high as 70% (World Health Organization, 2018).

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According to the most recent WHO guidelines on PA and sedentary behavior (Bull et al., 2020), all adults benefit from regular PA, with many of those benefits being observed within average weekly volumes of 150–300 min of moderate intensity or 75–150 min of vigorous intensity, or a combination of both types (American College of Sports Medicine, 2021). In this sense, PA should be integrated into the settings in which people live (World Health Organization, 2018), since all the activity at work, leisure, home or during transportation contributes to reach the recommended levels of PA (Bull et al., 2020). Hence, all adults should decrease the amount of time spent on sedentary behavior (Bull et al., 2020; Santos et al., 2022). This seems to be particularly relevant among college students, since there is evidence that most of them are unaware of PA recommendations for adults (Martins et al., 2019). Besides, the transition to college is known to be a major event in life which is associated with a decrease in PA levels (Engberg et al., 2012).

1.1. *Active commuting and physical activity*

In developed countries, most individuals rely on their private cars for transportation, despite the potential of daily commuting to promote PA (Niederseer et al., 2020). In this regard, the promotion of active modes of transport, such as walking or cycling (i.e., active commuting - AC) has been receiving growing attention as a possible and viable strategy to encourage active living among workers and students (Shephard, 2008). Niederseer et al. (2020) point that, by engaging in AC for 30 min a day, with moderate intensity, individuals could reach the recommended levels of daily PA.

This perspective is further supported by current evidence regarding AC and PA. For instance, Larouche et al. (2014) conducted a systematic review in which over than 81% of the analyzed studies showed positive associations between AC and PA levels. The mentioned authors also found cycling for transport to be positively associated with cardiovascular fitness. These findings are in line with those of Henriques-Neto et al. (2020), who found AC by cycling to be particularly important to improve physical fitness, by increasing PA levels. Walking for commuting purposes also seems to be beneficial, as Martin et al. (2016) found it to contribute to about one third of the total amount of moderate-to-vigorous PA among high school students, on schooldays.

The importance of AC is also acknowledged by the World Health Organization (2018), which contemplates it as one of the pathways to help attain several Sustainable Development Goals, namely: decent work and economic growth; industry, innovation and infrastructure; sustainable cities and communities; climate action; peace, justice and strong institutions; and good health and well-being.

1.2. *Benefits of active commuting on health*

The benefits of AC on health are supported by current literature. AC has been linked to a lower risk of all-cause mortality, diabetes (Dinu et al., 2019) and cardiovascular disease (Dinu et al., 2019; Eriksson et al., 2020). Accordingly, Henriques-Neto et al. (2020) point that a positive relationship has been found between AC and several attributes related to physical, as well as cardiorespiratory, fitness. Evidence also supports that AC has a positive effect on body composition (Falconer et al., 2015; Henriques-Neto et al., 2020), with active commuters having a lower risk of being overweight, compared to passive commuters (te Velde et al., 2017). In addition to its benefits on physical health, AC has also been linked to mental health benefits (Jacob et al., 2021; Kleszczewska et al., 2020).

Furthermore, Mytton et al. (2016) found that AC is associated with a reduction in sickness absence among adult workers, as well as an increase in self-reported well-being. Likewise, one study conducted by Neumeier et al. (2020) supports the importance of AC on quality of life. The mentioned authors (Neumeier et al., 2020) found that adult workers who actively commute to work report a greater quality of life, compared to passive commuters, with the dimensions of general health, physical function, mental health, and vitality displaying statistically significant differences between groups.

1.3. *The role of the built environment on physical activity, active commuting and quality of life*

Over the last years, the popularity of AC has been decreasing in many countries (World Health Organization, 2018). In this sense, it is important to understand what may lie behind people's commuting choices (Figueiredo et al., 2021). Evidence points that both natural and built environments have an important role in the modulation of PA (Cerin et al., 2006), and the design elements of the built environment are known to either encourage or discourage active living (Wold Health Organization, 2006), having the potential to contribute nearly 90 min/week to overall PA (Sallis et al., 2016). One study conducted by Bauman et al. (2012) points that overall PA is positively correlated with environmental features, such as the transportation environment, aesthetics, and the existence of recreation facilities and locations. Accordingly, one study developed by Sallis et al. (2016) across several countries, found positive and significant associations between PA levels and environmental attributes, such as residential density, access to public transports, and access to parks.

Past research also supports the fact that the physical environment seems to influence AC, since it has been associated with walking (Saelens et al., 2003a; Saelens et al., 2003b) and cycling for transport (Saelens et al., 2003b). Accordingly, Cerin et al. (2006) found positive correlations between AC and built environment attributes. In a recent study, Patterson et al. (2020) also reported an association between supportive physical environment factors and AC, particularly among men. In line with these findings, in a longitudinal study developed among adults, Yang et al. (2017) found that supportive environmental features (e.g., streetlights; greater density of employment destinations; shorter distance (<10 km) between home and work), not only predict the uptake of AC, but are also associated with its maintenance. There is also evidence of the importance of the built environment regarding AC to school among college students. For instance, Molina-García et al. (2019) found that students living in areas with greater walkability reported more frequent AC trips to school compared to their counterparts who lived in neighborhoods with lower walkability.

Regarding the role of the built environment on quality of life, evidence is still scarce, and some of it is conflicting. For instance, Sallis et al. (2009) found no positive associations between quality of life and neighborhood walkability. On the other hand, Gao et al. (2016) reported significant associations between perceived neighborhood attributes and both mental and physical well-being indicators. Specifically, Gao et al. (2016) found that mental well-being was positively and significantly associated with increased walkability, diversity of resources, ease of access, safety, aesthetics, and street connectivity. Gao et al. (2016) also found physical well-being to be associated with diversity of resources, ease of access, and aesthetics. Accordingly, Sarmiento et al. (2010) found positive associations between quality of life indicators and perceived built environment attributes, such as land use heterogeneity and access to parks. Taking these inconsistencies into account, it is of upmost relevance to further analyze how the built environment might relate to quality of life in other populations, with different cultural settings, such as students.

1.4. Measuring built environment attributes

According to Cerin et al. (2006) there are objective (i.e. geographic information systems) and subjective means of measuring attributes of the built environment. Regarding subjective means, there are several validated measures in the literature, such as the Physical Activity Neighborhood Environment Survey (Sallis et al., 2010), the Neighborhood Environment Walkability Scale – NEWS (Saelens et al., 2003a), and its abbreviated form – NEWS-A (Cerin et al., 2006). The NEWS and the NEWS-A are currently the most popular across the world (Cerin et al., 2013). The NEWS (Saelens et al., 2003a) is a valid self-report measure of neighborhood environment characteristics, and includes 68 items grouped into 8 subscales: Residential density (i.e., frequency of several types of residences, such as single-family detached homes or 1-3 stories condos); Land use mix-diversity (i.e., walking proximity to non residential land uses, such as restaurants or stores); Land use mix-access (i.e., access to non residential land uses); Street connectivity (i.e., existence of gridlike street patterns, with short block lengths and few cul-de-sacs); Walking/cycling facilities (i.e., sidewalks and pedestrian/bike trails); Aesthetics (i.e., presence of attractive natural sights and/or attractive buildings); Traffic safety (i.e., slow speed traffic on nearby streets); and Crime safety (i.e., low crime rate). This instrument has a high level of consistency, with most of its subscales showing a good test-retest reliability, with scores above 0.75 (Saelens et al., 2003a). Considering that the NEWS is a long questionnaire, Cerin et al. (2006) developed the NEWS-Abbreviated (NEWS-A), a shorter version of the NEWS, maintaining the structure of 8 subscales, but reducing the number of items down to 54. In order to select which items would be removed to create the abbreviated version, Cerin et al. (2006) identified overlapping items, and kept the ones with the best psychometric properties (i.e., better criterion validity; contribution of a specific item to the criterion validity of its factor; magnitude of Intraclass Correlation Coefficient (ICC); Test retest-reliability; and higher factor loadings and significant loadings in the respective factors). The authors also excluded other items considered to have low criterion validity. Hence, for the development of the NEWS-A, the following items have been removed: "*I can do most of my shopping at local stores.*" – Land use mix-access; "*There are walkways in my neighborhood that connect cul-de-sacs to streets, trails, or other cul-de-sacs.*" – Street connectivity; "*There are many four-way intersections in my neighborhood.*" – Street connectivity; "*The sidewalks in my neighborhood are well maintained.*" – Walking/cycling facilities; "*There are bicycle or pedestrian trails in or near my neighborhood that are easy to get to.*" – Walking/cycling facilities; "*It is safe to ride a bike in or near my neighborhood.*" – Walking/cycling facilities; "*Trees give shade for the sidewalks in my neighborhood.*" – Aesthetics; "*My neighborhood is generally free from litter.*" – Aesthetics; "*There is so much traffic along the street I live on that it makes it difficult or unpleasant to walk in my neighborhood.*" – Traffic safety; "*The speed of traffic on the street I live on is usually slow.*" – Traffic safety; "*The crosswalks in my neighborhood help walkers feel safe crossing busy streets.*" – Traffic safety; "*When walking in my neighborhood there are a lot of exhaust fumes.*" – Traffic safety; "*I see and speak to other people when I am walking in my neighborhood.*" – Crime safety; and "*My neighborhood is safe enough so that I would let a* 10-yr-*old boy walk around my block alone in the daytime.*" – Crime safety.

To develop the original version of the NEWS, Saelens et al. (2003a) recruited 107 participants from two nonadjacent neighborhoods, previously categorized as having high and low walkability. Later, in order to develop and validate the NEWS-A, Cerin et al. (2006) extended the sample size (n = 1286), which they considered to be small in the original NEWS study, and involved a wider neighborhood variability, since the previous work from Saelens et al. (2003a) only included two pre-selected neighborhoods. Still, in a later study, Cerin et al. (2009) aimed to cross-validate both the original NEWS and the NEWS-A in a different location and population within the USA, taking into account that the previous studies were driven in settings with limited environmental variability. Although both the NEWS and the NEWS-A questionnaires were shown to have adequate levels of factorial and criterion validity, Cerin et al. (2006) point that the NEWS-A showed better fit to the data and better criterion validity compared to the original version of the NEWS.

1.5. Present research

Taking into account that the original NEWS subscales were not based on an exploratory factor analyses (Saelens et al., 2003a), Cerin et al. (2006) also decided to assess the factorial validity of the a priori subscales of both the NEWS and the NEWS-A. However, Cerin et al. (2006) did not consider appropriate to include the first two subscales (i.e., Residential density; Land use mix-diversity) in a confirmatory factor analysis (CFA), due do their response format (i.e., Residential density subscale items are first coded form 1 to 5, and are then calculated based upon the average density attributed to the various residence types; Land use mix-diversity is assessed according to the walking proximity of several stores/facilities, and its responses range from 1 to 5 min walking distance to >30 min walking distance, and the responses are then coded from 1 to 5; All the other subscales are rated according to a four-point Likert scale). In this sense, ultimately, the responses to the items related to the Residential density and the Land use mix-diversity subscales are also coded on a Likert-type scale, but using a five-point scale instead of a four-point scale. Therefore, these latent factors should also be included in a factor analysis. To the best of our knowledge, none of the studies which aimed to validate the factorial structure of the

Table 1
Summary of goodness-of-fit indexes for the tested models.

Authors	Model	Scale	Country	χ2	df	CFI	TLI	SRMR	RMSEA	CI
Cerin et al. (2006)	Six-correlated factor: a priori	NEWS	USA	5701.5*	1373	.82	.81	.074	.050	.048, .051
	Six-correlated factor: re-specified	NEWS	USA	3400.2*	1135	.92	.92	.063	.040	.038, .041
	Six-correlated factor: based[¥]	NEWS-A	USA	1052.9*	442	.97	.97	.052	.033	.030, .035
	Six-correlated factor: re-specified	NEWS-A	USA	1020.7*	445	.97	.97	.067	.032	.029, .034
Cerin et al. (2009)	Six-correlated factor: a priori	NEWS	USA	2881*	1135	.92	.91	.066	.038	.035, .041
	Six-correlated factor: re-specified	NEWS	USA	2801*	1135	.92	.92	.070	.036	.033, .040
	Six-correlated factor: a priori	NEWS-A	USA	1099*	445	.96	.95	.113	.030	.024, .035
	Six-correlated factor: re-specified	NEWS-A	USA	1066*	445	.97	.96	.076	.026	.020, .032
Cerin et al. (2013)	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Australia	593[†]	161	.934	–	.040	.041	.037, .044
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Australia	534[†]	139	.934	–	.044	.042	.039, .046
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Belgium	914[†]	202	.856	–	.058	.056	.052, .059
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Belgium	462[†]	141	.907	–	.055	.045	.040, .049
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Brazil	340[†]	181	.906	–	.055	.046	.040, .056
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Brazil	249[†]	155	.927	–	.053	.040	.031, .049
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Colombia	351[†]	202	.928	–	.068	.044	.036, .051
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Colombia	262[†]	175	.956	–	.065	.036	.026, .044
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Czech Republic	453[†]	201	.897	–	.066	.053	.046, .059
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Czech Republic	357[†]	171	.915	–	.060	.049	.042, .056
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Denmark	491[†]	202	.901	–	.052	.048	.043, .053
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Denmark	316[†]	179	.948	–	.047	.035	.029, .041
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Hong Kong	247[†]	142	.952	–	.044	.041	.032, .049
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Hong Kong	248[†]	144	.953	–	.045	.040	.032, .048
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Mexico	630[†]	202	.862	–	.068	.056	.050, .062
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Mexico	369[†]	177	.915	–	.065	.046	.039, .053
	Eight-correlated factor: a priori[‡]	NEWS-A	New Zealand	722[†]	202	.896	–	.045	.043	.040, .047
	Eight-correlated factor: final[‡]	NEWS-A	New Zealand	501[†]	173	.930	–	.042	.037	.033, .041
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	Spain	716[†]	202	.876	–	.065	.057	.052, .061
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	Spain	512[†]	174	.911	–	.060	.050	.045, .055
	Eight-correlated factor: a priori[‡]	NEWS/NEWS-A mix	UK	322[†]	161	.933	–	.044	.036	.030, .042
	Eight-correlated factor: final[‡]	NEWS/NEWS-A mix	UK	234[†]	137	.956	–	.045	.031	.024, .037
	Eight-correlated factor: a priori[‡]	NEWS	USA	581[†]	202	.940	–	.046	.042	.039, .046
	Eight-correlated factor: final[‡]	NEWS	USA	480[†]	173	.951	–	.046	.041	.036, .045
Cerin et al. (2019)	Six-correlated factor: a priori	NEWS-Y	Australia	478[†]	194	.864	–	.078	.082	.073, .091
	Six-correlated factor: final	NEWS-Y	Australia	192[†]	124	.958	–	.068	.050	.036, .064

(continued on next page)

Table 1 (*continued*)

Authors	Model	Scale	Country	χ2	df	CFI	TLI	SRMR	RMSEA	CI
	Six-correlated factor: a priori	NEWS-Y	Belgium	612†	194	.860	–	.100	.094	.085, .102
	Six-correlated factor: final	NEWS-Y	Belgium	204†	125	.961	–	.078	.052	.039, .064
	Six-correlated factor: a priori	NEWS-Y	Brazil	442†	194	.844	–	.056	.051	.045, .057
	Six-correlated factor: final	NEWS-Y	Brazil	209†	126	.935	–	.047	.037	.028, .045
	Six-correlated factor: a priori	NEWS-Y	Hong Kong	1268†	194	.905	–	.067	.066	.062, .069
	Six-correlated factor: final	NEWS-Y	Hong Kong	624†	128	.944	–	.056	.055	.051, .059
	Six-correlated factor: a priori	NEWS-Y	India	441†	194	.869	–	.065	.066	.057, .073
	Six-correlated factor: final	NEWS-Y	India	180†	129	.964	–	.061	.037	.023, .049
	Six-correlated factor: a priori	NEWS-Y	Malaysia	493†	194	.889	–	.084	.068	.061, .076
	Six-correlated factor: final	NEWS-Y	Malaysia	239†	125	.947	–	.070	.053	.042, .063
	Six-correlated factor: a priori	NEWS-Y	New Zealand	423†	194	.877	–	.072	.065	.058, .073
	Six-correlated factor: final	NEWS-Y	New Zealand	240†	128	.914	–	.057	.048	.038, .057
	Six-correlated factor: a priori	NEWS-Y	Nigeria	432†	194	.870	–	.078	.071	.062, .080
	Six-correlated factor: final	NEWS-Y	Nigeria	211†	133	.951	–	.070	.049	.036, .061
	Six-correlated factor: a priori	NEWS-Y	Spain	527†	194	.899	–	.064	.069	.063, .075
	Six-correlated factor: final	NEWS-Y	Spain	308†	126	.948	–	.049	.056	.048, .064
	Six-correlated factor: a priori	NEWS-Y	USA	933†	194	.897	–	.067	.064	.060, .068
	Six-correlated factor: final	NEWS-Y	USA	368†	129	.955	–	.065	.045	.039, .050

Notes: χ2 = qui-square test; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; CI= Confidence Interval; **p* level not specified; ¥Based on the re-specified model of the NEWS; ‡six factors plus two single items common for all countries; †p < .001 level.

NEWS-A included the Residential density and Land use mix-diversity subscales in their analysis, since the procedure described above was followed by other studies which conducted a CFA on the NEWS/NEWS-A (Cerin et al., 2009, 2013), and the NEWS-Youth (Cerin et al., 2019). The summary of goodness-of-fit indexes for the tested models of the mentioned instruments across several countries can be consulted in Table 1.

Cerin et al. (2006) also found that the two measurement models for the NEWS-A (individual level and blockgroup level), although similar, were not equivalent, since some attributes did not group in the same manner. The referred authors identified six individual level factors (i.e., Land use mix-access; Street connectivity; Infrastructure and safety for walking; Aesthetics; Traffic hazards; Crime) and five blockgroup level factors (i.e. Land use mix-access and infrastructure for walking; Physical obstacles to walking/cycling; Aesthetics and friendliness; Traffic hazards; Crime). However, this blockgroup level factorial structure was later refuted by Cerin et al. (2009), as their study identified a sixth factor in this blockgroup level model (i.e. Physical obstacles to walking). Therefore, Cerin et al. (2009) recommend the use of the individual level measurement model, instead of the blockgroup one.

In order to collect data regarding the built environment, the International Physical activity and the Environment Network (IPEN) Adult has been using either the NEWS or the NEWS-A questionnaire (Kerr et al., 2013). To our knowledge, Portugal lacks self-report measures of the neighborhood environment. During our research, a Portuguese study from 2014 was found (Paisana-Morais et al., 2014), which validated a scale, based on the Australian version of the NEWS (Cerin et al., 2008), to evaluate the perceived neighborhood walkability among citizens aged over 65 years old. As far as the NEWS is concerned, we only found one study (Cerin et al., 2019) which mentions the existence of a Portuguese version for the youth, but little information is provided about this version, as the Portuguese sample was too small and, therefore, this NEWS-Youth version was excluded from the study's CFA. As far as the adult Portuguese population is concerned, we could not find any specific self-report measure regarding the characteristics of the neighborhood environment. Still, evidence points that there is a need to target young adults, such as post-secondary students, in health promotion campaigns, focusing the importance of engaging in more healthy lifestyles, including the ones which relate to PA (Kwan et al., 2013). Besides, as mentioned above, there seems to be a general unawareness of the recommended levels of PA among college students (Martins et al., 2019). Thus, taking the worrying health-related lifestyles among college students into account (Aceijas et al., 2017), with individuals reporting lack of time as being one of the most common reasons not to engage in PA (Ashton et al., 2017), AC might be a viable way to reach daily PA recommended levels (Bopp et al., 2012).

In this context, considering the important role of the built environment in the modulation of PA (Cerin et al., 2006; Wold Health Organization, 2006; Bauman et al., 2012; Sallis et al., 2016) and AC (Saelens et al., 2003a; Saelens et al., 2003b; Cerin et al., 2006; Yang et al., 2017; Molina-García et al., 2019; Patterson et al., 2020), and taking into account the fact that the NEWS-A has not been validated in Portugal, the main purpose of the present study is to adapt and validate the NEWS-A to Portuguese college students. Furthermore, as previous studies regarding the NEWS-A (Cerin et al., 2006, 2009, 2013) did not include the Residential density and the Land use mix-diversity subscales in their CFA, the present study also aims to include the mentioned subscales in its analysis. Besides, considering that evidence of the associations between the built environment and quality of life is still scarce, the secondary goal of the present study is to provide further evidence on this matter, by examining how perceived neighborhood environment attributes relate, not only to PA, but also to quality of life constructs. We consider this to be important, since it enhances a more comprehensive perspective on how these variables may correlate to one another, which could provide valuable information to design future health interventions regarding the promotion of PA, AC and quality of life.

2. Methods

2.1. Participants

In order to develop the present study, the following inclusion criteria were considered: a) Being between 18 and 65 years-old; b) Attending college; c) Being fluent in Portuguese; d) Accepting the informed consent terms; and e) Being open to voluntarily participate in the study. Subjects not fulfilling all the inclusion terms were excluded from the study. A total of 507 college students (female = 346; male = 161), aged between 18 and 65 years (M = 25.05; SD = 8.76) were recruited. As far as their attended educational level is concerned, one (0.2%) student was attending a specialization course, 35 students (6.9%) a short cycle program degree, 325 (64.1%) a bachelors' degree, 10 (2%) a post-graduate degree, 134 (26.4%) a masters' degree, and two (0.4%) a doctoral degree. Regarding their study field, 17 (3.4%) students were attending tourism courses, 22 (4.3%) technology courses, 26 (5.1%) arts/design courses, 30 (5.9%) social sciences courses, 30 (5.9%) life sciences courses, 32 (6.3%) education courses, 71 (14%) sports sciences courses, 79 (15.6%) engineering courses, 86 (17%) health sciences courses, and 112 (22.1%) management/economics courses. Concerning their usual commuting mode, 146 (28.8%) students were classified as active commuters (i.e., walking, cycling), 253 (49.9%) as passive commuters (i.e., car, motorcycle) and 108 (21.3%) as mixed commuters (i.e., public transport and walking).

The A-priori sample size calculator for CFA (Soper, 2022) was used to calculate the minimum required participants for this study. The following inputs were used: anticipated effect size = 0.03; desired statistical power = 0.95; probability level = 0.05, number of latent variables = 8, number of observed variables = 54. The results suggested a minimum of approximately 341 participants, which provided support that the current sample size is acceptable.

2.2. Procedures: translation of the NEWS-A

Regarding the translation and adaptation of the NEWS-A (Cerin et al., 2006) to Portuguese, after obtaining permission from the original authors, the procedures were based on the recommendations of Brislin (1980). Therefore, the following steps have been followed: (a) Preliminary translation of the questionnaire; (b) Submission to a first evaluation panel, with the initial Portuguese version being reviewed by specialists from different fields of scientific expertise; (c) Submission to a second evaluation panel, independent from the first panel; (d) Administration of the questionnaire to 30–40 college students to evaluate the temporal reliability; and (e) Continuous revision of the questionnaire, according to eventual participants' commentaries/suggestions regarding Portuguese language interpretation issues. The initial and final Portuguese versions of the NEWS-A (NEWS-A PT) can be consulted in Appendices A and B, respectively. Concerning the test-retest reliability of the NEWS-A-PT, according to probability theory, a sample size of N = 30 is considered acceptable and recommended for this type of test (Hair et al., 2019). The recommended time between survey administrations ranges from 1 to 4 weeks (Banville et al., 2000; Vallerand, 1989). Accordingly, in the present study, 32 voluntary college students were asked to fill the questionnaire twice, with a 2–4 weeks gap between the two administrations.

2.3. Procedures: data collection

Data collection was driven according to the Declaration of Helsinki, and the Institutional Research Ethics Committee provided its approval for the study implementation (omitted for review purpose). The present study was cross-sectional in design, and several institutional deans/headmasters were contacted in order to distribute online surveys among their students, using their internal mailing lists. A total of 20 institutions were reached, and 12 (60%) divulged the survey, four (20%) did not reply, and four (20%) refused to collaborate due to institutional formalities constraints. Before the data collection, potential participants were informed about the main goals of the study, the estimated time to complete the survey (about 12 min) and were ensured that all ethical procedures were respected. Prior to completing the questionnaires, participants had to fill a checkbox, ensuring that they understood the study purposes, and that they accepted to participate. Participants were thanked their contribution, but no compensation was provided.

2.4. Measures

In order to evaluate the perceived neighborhood environment, participants completed the NEWS-A (Cerin et al., 2006), translated into Portuguese (as described above). The original version (Cerin et al., 2006) includes 54 items, grouped into six latent factors: Land use mix-access (e.g., "*There are many places to go within walking distance at my home.*"); Street connectivity (e.g., *There are many alternative routes for getting from place to place in my neighborhood.*"); Infrastructure and safety for walking (e.g., *"There are sidewalks on most of the streets in my neighborhood.*"); Aesthetics (e.g., "*There are trees along the streets in my neighborhood.*"); Traffic hazards (e.g., "*Most drivers exceed the posted limits while driving in my neighborhood.*"); Crime (e.g., "*There is a high crime rate in my neighborhood.*"). The instrument also includes two multi-item subscales, namely: Residential density (e.g., "*How common are apartments or condos 4-6 stories in your immediate neighborhood?*"); and Land use mix-diversity (e.g., *"About how long would it take to get from your home to the nearest businesses or facilities listed below if you walked to them? Fruit/vegetable market.")*. Additionally, the NEWS-A also encompasses four single item subscales: Lack of parking (i.e., "P*arking is difficult in local shopping areas.*"); Lack of cul-de-sacs (i.e., "*The streets in my neighborhood do not have many cul-de-sacs."*); Hilliness (i.e., "*The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.*"); and Physical barriers (i.e., *"There are major barriers to walking in my neighborhood that make it hard to get from place to place (for example, freeways, railway lines, rivers, canyons, hillsides).")*.

To assess the levels of PA, the translated version of the Short Form of the International Physical Activity Questionnaire (IPAQ) was used (Craig et al., 2003). The referred instrument includes eight questions: two for vigorous PA; two for moderate PA; two for walking PA; and two regarding sitting time. However, in the present study, information about sitting time was not used. The IPAQ short form allows to calculate separate scores for walking PA (i.e., Walking MET-minutes/week = 3.3*walking minutes*walking days), moderate PA (i.e., Moderate MET-minutes/week = 4*moderate activity minutes*moderate activity days), and vigorous PA (i.e., Vigorous MET-minutes/week = 8*vigorous activity minutes*vigorous activity days) and, by computing the duration (in minutes) and frequency (in days) of the three different types of PA (i.e., Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores), it provides a total score for self-reported PA (IPAQ Group, 2005).

Regarding the assessment of quality of life, the Portuguese version of the World Health Organization Quality of Life Instruments-Bref (WHOQOL-Bref; Vaz Serra et al., 2006) was used. It consists of a 26-item instrument, organized into four distinct domains, namely: Physical health (e.g., *"To what extent do you feel that physical pain prevents you from doing what you need to do?"*); Psychological (e.g., *"How much do you enjoy life?"*); Social relationships (e.g., *"How satisfied are you with your personal relationships?"*); and Environment (e.g., *"How safe do you feel in your daily life?"*). Additionally, the referred instrument also has two questions included in the facet "Overall quality of Life and General Health" (i.e., *"How would you rate your quality of life?"*; and "*How satisfied are you with your health?"*).

2.5. *Statistical analysis*

2.5.1. *Test-retest analysis*

Regarding the test-retest reliability, the correlations from responses given in the two NEWS-A-PT administrations were calculated in SPSS (IBM Corp., 2020) for each item using the Intraclass Correlation Coefficient (ICC), and results >0.70 were considered acceptable (Bartko, 1966).

2.5.2. *Factor analysis*

Analyses were performed in Mplus 7.4 (Muthén and Muthén, 2010). As previous empirical studies (Cerin et al., 2006, 2009) gave support for a 54-item measurement model, we tested the correlated nine-factor model (six a priori factors, plus the Residential density and Land use mix-diversity subscales. The single-item subscales were grouped into one factor) using CFA. We considered the Robust Maximum Likelihood estimator to correct any non-normality bias. In the factor analysis, items were allowed to load on their pre-defined factors, suppressing cross-loadings on unintended factors. No missing data at the item level was found due to how the questionnaire was built. Due to the over-sensitivity of the chi-square statistics on large samples and the model complexity (Hair et al., 2019), we considered several common goodness-of-fit indices to assess model fit, namely: Tucker-Lewis Index (TLI); Comparative Fit Index (CFI); Root Mean Square Error of Approximation (RMSEA) and its respective Confidence Interval at 90% (CI 90%); and Standardized Root Mean Residual (SRMR). For CFI and TLI, values ≥ 0.90 are typically interpreted to reflect adequate fit and for SRMR and RMSEA, values of ≤0.080 are indicative of adequate fit to the data (Hair et al., 2019; Marsh et al., 2004). Nonetheless, chi-square statistics and degrees of freedom will be reported for transparency.

Analyses of the individual items should display significant loadings on the target factor, with factor loadings greater than 0.50 and significant ($p < .05$), and they should explain at least 25% of the variance (Hair et al., 2019). To assess internal consistency, composite reliability coefficients were calculated for the subscale scores, and values ≥ 0.70 were considered to be acceptable (Raykov, 2016).

The Average Variance Extracted (AVE) and the comparison between squared root of the AVE and squared correlations were used to investigate convergent and discriminant validity, respectively. AVE is an established approach to test convergent validity (Hair et al., 2019) and scores above 0.50 are deemed to be acceptable. Constructs are identified as distinct when the square root of the AVE value is larger than the correlation between the two constructs displaying discriminant validity (Hair et al., 2019).

2.5.3. *Correlational analysis*

In order to correlate PA, perceived neighborhood environment and quality of life, Pearson correlations were calculated in SPSS (IBM Corp., 2020) considering levels of PA, neighborhood environment constructs, and quality of life factors. Significance levels were set at $p < .05$.

Table 2
Test-retest reliability.

Factors	ICC
Residential density	
Item 1	.70***
Item 2	.84***
Item 3	.75***
Item 4	.87***
Item 5	.94***
Item 6	.92***
Land use mix-diversity	
Item 1	.88***
Item 2	.84***
Item 3	.80***
Item 4	.76***
Item 5	.78***
Item 6	.88***
Item 7	.87***
Item 8	.89***
Item 9	.69***
Item 10	.80***
Item 11	.89***
Item 12	.83***
Item 13	.69***
Item 14	.89***
Item 15	.75***
Item 16	.78***
Item 17	.88***
Item 18	.77***
Item 19	.91***
Item 20	.76***
Item 21	.51*
Item 22	.55*
Item 23	.91***
Land use mix-access	
Item 1	.89***
Item 2	.89***
Item 3	.88***
Street connectivity	
Item 1	.55*
Item 2	.74***
Infrastructure and safety for walking	
Item 1	.88***
Item 2	.79***
Item 3	.84***
Item 4	.78***
Item 5	.68***
Item 6	.89***
Aesthetics	
Item 1	.75***
Item 2	.53*
Item 3	.69***
Item 4	.83***
Traffic hazards	
Item 1	.59**
Item 2	.66**
Item 3	.56*
Crime	
Item 1	.44
Item 2	.38
Item 3	.72***
Lack of parking	
Item 1	.14
Lack of cul-de-sacs	
Item 1	.61**
Hilliness	
Item 1	.25
Physical barriers	
Item 1	.46*

Notes: *$p < .05$; **$p < .01$; ***$p < .001$.

3. Results

3.1. Test-retest analysis

As far as the test-retest reliability is concerned, results are shown in Table 2. Regarding the items which remained in the final 32-item version of the NEWS-A-PT (see later), all but B13, F2, F3, H1 and H2 showed acceptable results (>0.70). Therefore, in general, the NEWS-A-PT displayed acceptable levels of temporal reliability.

3.2. Factor analysis

Fit indices of the CFA model for the NEWS-A-PT psychometric proprieties are shown in Table 3. The original 54-item model did not converge. Problems were found that the number of iterations exceeded. Considering that each latent factor should have at least three items, we eliminated factors that only had one item (factor I – Lack of parking; J – Lack of cul-de-sacs; K – Hilliness; and L – Physical barriers). Additionally, we eliminated factor D (Street connectivity) since it had two items. The revised 48-item also displayed poor fit. Factor loadings were analyzed, as well as significance levels and several items were eliminated as recommended, namely; three items of factor A (Residential density – A1; A2; and A3), six items of factor B (Land use mix-diversity – B1; B9; B19; B20; B21; and B22), three items of factor E (Infrastructure and safety for walking – E3; E4; and E5), and one item from factor F (Aesthetics – F1), with low factor loadings. The factor G (Traffic hazards) was eliminated since all items had loadings below cutoff (<0.5). Factor loadings of the 48-item model are represented in Table 4. The revised 32-item model provided acceptable fit to the data. While TLI was slightly below cutoff, it was close to surpass the 0.90 score. Thus, we moved on examining factor loadings using the correlated six-factor model (Factor A – Residential density; Factor B – Land use mix-diversity; Factor C – Land use mix-access; Factor E − Infrastructure and safety for walking; Factor F – Aesthetics; and Factor H – Crime).

Analyses on the correlated six-factor model with 32-items (see Table 4) revealed that all item loadings on the target factor were greater than 0.50 and loaded significantly at $p < .01$. Additionally, responses to each perceived neighborhood environment factor were found to be internally consistent, as all factors within the correlated six-factor model had composite reliability coefficient scores equal or above 0.70. Specifically, composite coefficients ranged between 0.70 (Factor E − Infrastructure and infrastructure for walking) and 0.92 (Factor B – Land use mixed-diversity).

Convergent validity was achieved as the square roots of AVE scores were above 0.50 as seen in Table 5. According to the squared correlations and square roots of AVE scores in Table 5, all factors demonstrated adequate discriminant validity. In general, the correlations of the correlated six-factor model showed significant associations, specifically: a) Residential density showed positive correlations with Land use mix-diversity, Land use mix-access, Infrastructure and safety for walking, and Crime); b) Land use mix-diversity displayed positive correlations with all the other factors; c) Land use mix-access was positively correlated with Residential density, Land use mix-diversity, Aesthetics, and Crime, while it showed a negative correlation with Infrastructure and safety for walking; d) Infrastructure and safety for walking showed positive correlations with Residential density, Land use mix-diversity, Aesthetics and Crime, and a negative correlation with Land use mix-access; e) Aesthetics was positively correlated with Land use mix-diversity, Land use mix-access and Infrastructure and safety for walking, and negatively correlated with Crime; f) Crime was positively correlated with Residential density, Land use mix-diversity, Land use mix-access and Infrastructure and safety for walking, and negatively correlated with Aesthetics.

3.3. Correlational analysis

Correlations between NEWS-A-PT factors and the levels of PA and quality of life constructs are seen in Table 6. Significant associations were found, namely: a) Land use mix-diversity was positively correlated with total PA, walking PA, Overall quality of life and general health, Psychological health, Social relationships and Environment; b) Land use mix-access was positively correlated with total PA, walking PA, Overall quality of life and general health, Physical health, Psychological health, Social relationships and Environment; c) Infrastructure and safety for walking displayed a positive correlation with total PA, walking PA, Overall quality of life and general health, Psychological health, Social relationships and Environment; d) Aesthetics was positively correlated with total PA, Overall quality of life and general health, Physical health, Psychological health, Social relationships and Environment; e) Crime was negatively correlated with Overall quality of life and general health, Physical health, Psychological health and Environment.

Table 3
Fit indexes of the NEWS-A-PT.

Model	$\chi2$	gl	CFI	TLI	SRMR	RMSEA (90% CI)
54-item model (12 factors)	Did not converge					
48-item model (7 factors)	2686.930	1059	.785	.771	.071	.055 (.052; .057)
32-item model (6 factors)	1119.989	506	.908	.899	.063	.049 (.045; .053)

Notes: $\chi2$ = qui-square test; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; CI90% = Confidence Interval at 90%; *p < .001.

Table 4
Factor loadings, standardized errors, and composite reliability coefficients of the correlated 48 item seven-factor model (left) and the 32-item correlated six-factor model (right).

48-item model			32-item model	
Factors	λ	SE	λ	SE
Residential density			*.79*	
Item 1	.42*	.06	–	–
Item 2	−.10	.06	–	–
Item 3	−.43	.04	–	–
Item 4	.83*	.02	.64*	.04
Item 5	.71*	.04	.95*	.04
Item 6	.51*	.06	.61*	.04
Land use mix-diversity			*.92*	
Item 1	.44	.05	–	–
Item 2	.74*	.03	.74*	.03
Item 3	.50	.04	.50*	.04
Item 4	.52	.04	.51*	.04
Item 5	.61	.04	.61*	.04
Item 6	.76	.02	.76*	.02
Item 7	.62	.04	.62*	.04
Item 8	.67	.03	.66*	.03
Item 9	.40	.04	–	–
Item 10	.64	.03	.63*	.04
Item 11	.62	.03	.62*	.03
Item 12	.68	.03	.68*	.03
Item 13	.51	.04	.50*	.04
Item 14	.72	.03	.71*	.03
Item 15	.61	.04	.62*	.04
Item 16	.61	.03	.61*	.03
Item 17	.71	.03	.72*	.03
Item 18	.54	.04	.54*	.04
Item 19	.48	.04	–	–
Item 20	.28	.06	–	–
Item 21	.42	.05	–	–
Item 22	.27	.05	–	–
Item 23	.68	.03	.68*	.03
Land use mix-access			*.74*	
Item 1	.75*	.03	.75*	.04
Item 2	.74*	.04	.75*	.04
Item 3	.49*	.05	.59*	.05
Infrastructure and safety for walking			*.70*	
Item 1	.76*	.04	.77*	.04
Item 2	.58*	.05	.58*	.04
Item 3	.28	.05	–	–
Item 4	.41	.05	–	–
Item 5	.27	.07	–	–
Item 6	.61*	.05	.60*	.05
Aesthetics			*.76*	
Item 1	.43	.05	–	–
Item 2	.85*	.03	.86*	.04
Item 3	.68*	.04	.67*	.04
Item 4	.60*	.05	.59*	.05
Traffic hazards				
Item 1	.57	.12	–	–
Item 2	−.42	.12	–	–
Item 3	.48	.11	–	–
Crime			*.87*	
Item 1	.88*	.02	.89*	.02
Item 2	.77*	.03	.77*	.04
Item 3	.83*	.02	.82*	.02

Notes: λ = standardized factor loadings; SE = Standard Errors; composite reliability coefficients are in italic; *$p < .01$.

4. Discussion

The main purpose of this study was to translate and validate the NEWS-A in a sample of Portuguese college students. The final psychometric testing of the 32-item model of the NEWS-A-PT revealed good properties. Additionally, correlational analyses were conducted considering neighborhood environment subscales, PA, and quality of life dimensions. These findings are discussed in more detail below.

Table 5
Convergent and discriminant validity analysis.

Factors	AVE	√AVE	1	2	3	4	5	6
1. Residential density	.56	.75	1	.03	.10	.10	.00	.04
2. Land use mixed-diversity	.39	.62	.17**	1	.34	.21	.04	.01
3. Land use mixed-access	.48	.69	.31**	.58**	1	.49	.07	.01
4. Infrastructure safety walking	.42	.65	.32**	.46**	−.70**	1	.05	.01
5. Aesthetics	.51	.71	−.06	.21**	.27**	.23*	1	.02
6. Crime	.68	.83	.21**	.10*	.11*	.12*	−.14*	1

Notes: AVE = Average Variance Extracted; below diagonal line = correlations; above diagonal line = squared correlations; *p < .05; **p < .01.

Table 6
Correlation analysis.

Factors	Total PA	Walking PA	Overall QoL and general health	Physical health	Psychological health	Social relationships	Environment
A. Residential density	.02	.07	−.01	−.04	−.02	.05	−.05
B. Land use mix- diversity	.18**	.12**	.12**	.06	.13**	.13**	.13**
C. Land use mix- access	.09*	.16**	.15**	.12**	.12**	.15**	.18**
E. Infrastructure safety walking	.11*	.17**	.18**	.08	.15**	.16**	.17**
F. Aesthetics	.10*	.07	.20**	.10*	.18**	.14**	.21**
H. Crime	.02	.05	−.14**	−.20**	−.13**	−.05	−.28**

Notes: *p < .05; **p < .01.

4.1. Test-retest analysis

As far as the test-retest analysis is concerned, problems were found in the translated 54-item version of the NEWS-A. Specifically, the following items displayed ICC values < 0.70: B9, B13, B21, B22 (Land use-mixed diversity); D1 (Street connectivity); E5 (Infrastructure and safety for walking); F2, F3 (Aesthetics); G1, G2, G3 (Traffic hazards), H1, H2 (Crime); I1 (Lack of parking); J1 (Lack of cul-de-sacs); K1 (Hilliness); and L1 (Physical barriers). The validation study of the NEWS-A (Cerin et al., 2006) used the test-retest reliability results of the original NEWS, obtained by Saelens et al. (2003a), whom provided the ICC values for each subscale, but not for each item. This makes direct comparisons with our study difficult, especially if we consider that the NEWS and the NEWS-A, although similar, are not equal. Nevertheless, although Saelens et al. (2003a) state that most NEWS subscales display ICC values > 0.75, they still reported values < 0.70 in some subscales, namely: Residential density (0.63); Street connectivity (0.63); and Walking/cycling facilities (0.58). Accordingly, a modified version of the NEWS, developed in Australia by Leslie et al. (2005), also reported test-retest reliability values < 0.70 in some items. Again, we reinforce that the NEWS and the NEWS-A are not equal. Hence, comparisons with the present study should be made with caution. Still, some of the items identified by Leslie et al. (2005) as having test-retest reliability values <0.70, were consistent with our findings. Specifically, the items equivalent to B21, D1, F2, G1, G2, H2, H3, I1, and L1displayed values < 0.70. These results suggest that some temporal reliability issues found in the Portuguese version of the NEWS-A (NEWS-A-PT), are common to the NEWS, in which the NEWS-A was based, and may not be specifically related to the translation and adaptation to Portuguese. Despite the temporal reliability issues found in the 54-item version of the NEWS-A-PT, the final version of the questionnaire only includes 32 items. Regarding the items which displayed ICC values < 0.70, only the following were included in the final version: B13, F2, F3, H1, H2, and H3. Nonetheless, some of these items were close to achieving acceptable scores of temporal reliability. In this sense, most items included in the final version of the NEWS-A-PT displayed ICC values > 0.70 and, therefore, the mentioned instrument displays acceptable levels of temporal reliability.

4.2. Factor analysis

As previously mentioned in the present study, past research supported the correlated six-factor model (i.e., Land use mix-access; Street connectivity; Infrastructure and safety for walking; Aesthetics; Traffic hazards; Crime) of the NEWS-A (Cerin et al. 2006, 2009). In addition to the mentioned six latent factors, a transcultural study conducted by Cerin et al. (2013) also analyzed two single item subscales common to several countries, namely: Lack of cul-de-sacs, and Physical barriers. However, all the mentioned studies excluded the Residential density and the Land use mix-diversity subscales stating that, due to their response format, they were not factor analyzable. However, as empirically tested in this study, since item response to the items related to Residential density and the Land use mix-diversity subscales are scored according to a Likert-type scale, these latent factors can and should be considered in a factor analysis. In CFA, model solutions allow all possible construct-relevant information to be modeled. Thus, the CFA approach makes full use of the multidimensional conceptualization of all neighborhood environment walkability constructs.

Besides, the proposed correlated six-factor model (Cerin et al. 2006, 2009) includes one latent factor with less than three items (Street connectivity – two items), which does not comply with existing guidelines suggesting that at least three items are needed from latent factor saturation and explained variance (Hair et al., 2019). Likewise, the transcultural study conducted by Cerin et al. (2013)

considered subscales with only two items in some of its analyzes (i.e., the Belgian and the British models only included two items in the Land use mix-access factor; the Street connectivity subscale was tested for two items in all countries; the Lack of cul-de-sacs and Physical barriers to walking single-item subscales were also tested for all countries), since not all items were common to all subscales of all the participant countries. Hence, to our knowledge, the present study was the first to assess the factorial structure of the complete 54-item version of the NEWS-A. As previously mentioned in the results section, the original 54-item model did not converge, and the Street connectivity factor, with less than three items, was excluded. The four single-item subscales were tested together but, as expected, they did not load into the same factor. Therefore, the four items were also eliminated. Still, with the resulting 48-item model displaying poor fit, factor loadings were analyzed and items were eliminated in accordance: A1, A2, A3 (Residential density); B1, B9, B19, B20, B21, B22 (Land use mix-diversity); E3, E4, E5 (Infrastructure and safety for walking); F1 (Aesthetics); and all three items from the Traffic hazards factor. Additionally, among the eliminated items, many of them had shown reliability values < 0.70 in our test-retest analysis (i.e., B9, B21, B22, D1, E5, G1, G2, G3, I1, J1, K1, and L1), further supporting the decision to eliminate them. It is worthy to mention that the procedure of taking psychometric proprieties in consideration to eliminate items, has also been endorsed by Cerin et al. (2006), when they adapted the NEWS-A from the original NEWS.

All items loaded significantly onto their predefined factor in the 32-item model, supporting factor validity. Furthermore, acceptable ICC were found in all six factors of the 32-item model, providing reliability of the factors associated to the NEWS-A-PT. AVE values indicated that convergent validity was achieved since scores were above cutoff (Hair et al., 2019). Additionally, we examined and confirmed discriminant validity for 15 of the 15 possible comparisons, meaning that factors are distinct between each other. By supporting both convergent and discriminant validity, the present study is in line with previous findings obtained by Cerin et al. (2006). Still, to our knowledge, this was the first study to include the Residential density and Land use mix-diversity subscales in this sort of analysis, which further strengthens the decision to include both subscales in the CFA model.

4.3. Correlational analysis

In general, significant associations between perceived neighborhood environment attributes and PA were found, which is consistent with previous findings (Bauman et al., 2012; Cerin et al., 2006; Molina-García et al., 2019; Patterson et al., 2020; Saelens et al., 2003a; Saelens et al., 2003b; Sallis et al., 2016; Patterson et al., 2020; Yang et al., 2017). Regarding overall PA, significant associations were found with the Land use mix-diversity, Land use mix-access, Infrastructure and safety for walking, and Aesthetics. This is aligned with the results obtained by previous authors. For instance, Bauman et al. (2012), found positive correlations between total PA and environment attributes such as transport environment, aesthetics, and the existence of recreation facilities and locations. In turn, Sallis et al. (2016) found positive and significant associations between PA levels and residential density, access to public transports, and access to parks. Regarding residential density, our results do not comply with the ones obtained by Sallis et al. (2016). As far as walking PA is concerned, based on the NEWS-A (Cerin et al., 2006) scoring protocol, higher scores in the Residential density, Land use mix-diversity, Land use mix-access, Infrastructure and safety for walking, and Aesthetics subscales, are deemed to denote higher walkability, as opposed to the Crime subscale. In general, our results support this assumption, except for the Residential density and Crime subscales, which were positively, but not significantly, associated with walking PA. Interestingly, although Cerin et al. (2006) expected otherwise, they also found positive associations between the Crime subscale and walking PA. Although our study did not control for other variables, we hypothesize that this positive association could be due to the influence of some other variable, such as socioeconomic status. For instance, individuals with a low socioeconomic status living in areas with higher crime rates, could gather less conditions to use their own private vehicles, being more dependent on walking PA for transport purposes.

Regarding the associations between perceived neighborhood environment characteristics and quality of life, we found positive and significant associations between quality of life indicators and the Land use mix-diversity, Land use mix-access, Infrastructure and safety for walking, and Aesthetics subscales. In turn, the Residential density subscale displayed no significant associations with quality of life indicators. Regarding the Crime subscale, we found significantly negative associations with several quality of life indicators, namely: Overall quality of life and general health, Physical health, Psychological health and Environment. In this sense, in general, our results are conflicting with those obtained by Sallis et al. (2009), whom did not find positive associations between quality of life and neighborhood walkability. On the other hand, our findings support those of Gao et al. (2016) and Sarmiento et al. (2010), which found positive associations between quality of life indicators and perceived neighborhood environment attributes. Since the mentioned studies were conducted in multiple settings, in countries with different socioeconomic and cultural backgrounds, further studies are needed in order to clarify the associations between perceived neighborhood environment characteristics and quality of life indicators.

4.4. Practical implications

As previously mentioned, the transition to college is associated with the adoption of unhealthy habits, such as the decrease of PA levels (Engberg et al., 2012). Besides, the recommended levels of PA for adults seem to be widely unknown among Portuguese college students (Martins et al., 2019). These facts make Portuguese college students a subgroup of particular interest, as far as the promotion of PA is concerned. Thus, since PA should be integrated into the settings in which people live (World Health Organization, 2018), its promotion must be done holistically and, when it comes to promoting PA, AC and quality of life, the neighborhood environment definitely has an important role to play. In this sense, the present study provides Portuguese stakeholders and policymakers a valuable tool to assess and to further understand how Portuguese college students perceive their built environment, which may allow more targeted interventions regarding its modulation. This might be particularly important to develop specific future programs to promote PA, AC and quality of life among the studied population.

4.5. Limitations and agenda for future research

The present study makes a valuable contribution to the literature, not only by providing a valid and reliable instrument to assess perceived neighborhood environment characteristics, but also by producing more evidence on how this perception is associated with self-reported PA and quality of life indicators. In addition, considering the extent of the NEWS-A, this 32-item version could decrease the participants burden in future research, since we reduced the scale according to theoretical and statistical results. Still, it entails several limitations that must be given full consideration. First, it is important to consider that this was a cross-sectional study, which does not allow causality inferences. For instance, it is not possible to determine whether perceived neighborhood environment characteristics actually influence PA and quality of life, or if PA levels and perceived quality of life influence perceived neighborhood environment characteristics. By designing longitudinal studies, future researchers could help clarify these associations.

Furthermore, variables regarding PA levels, quality of life indicators, and neighborhood environment characteristics were collected using self-reported measures, which may have biased some information. To address this issue, future studies regarding this subject should cross information collected by subjective measures with more objective ones (e.g., using accelerometers to measure PA levels, and geographical information systems to access attributes related to the built environment), since they could provide more accurate data.

Besides, the present instrument has been validated in a population of college students, and not in the general adult population. This might limit its future use, and we suggest that future studies seek to cross-validate the NEWS-A-PT to a more general adult population. Still regarding the NEWS-A-PT, our sample included college students from all over the country, which entails multiple regional idiosyncrasies, regarding both cultural and geographical aspects. Additionally, while some students are expected to live in highly urbanized regions, others may live in rural areas. Therefore, this may have influenced some responses to the mentioned instrument, by increasing variability. This problem could be addressed in future studies, by including samples from more specific and well-defined geographical areas. Ultimately, although we provided a comprehensive factor analysis on the NEWS-A, which we believe helped solving some of the instruments' inconsistencies, it resulted in a 32-items instrument, with a different factorial structure when compared to studies developed in other countries. In this sense, future hypothetical transcultural studies including the NEWS-A-PT could make comparability between countries more difficult.

5. Conclusion

In summary, the present study provides empirical support for the validity and reliability of the six-factor and 32-item version of the NEWS-A-PT for Portuguese college students. Future cross-validation studies could be needed, in order to use the instrument in other samples (e.g., Portuguese adult workers).

Besides, the present study also supports the assumption that perceived neighborhood environment characteristics are associated with both PA and quality of life indicators. This suggests that investing in supportive built environment attributes may help increasing PA levels and quality of life indicators among college students. Nevertheless, the present study does not clarify whether investing in physical changes of the neighborhood environment could be enough to change perceived neighborhood environment walkability. Therefore, future studies should focus on how physical changes in the built environment translate into individual perceptions of neighborhood walkability. Furthermore, we also encourage future researchers to develop longitudinal studies, in order to further understand how perceived neighborhood environment, PA and quality of life may influence one another.

Approval

Approval from the Ethical Committee of Polytechnique of Leiria (CE/IPLEIRIA/18/2021) was obtained.

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CRediT authorship contribution statement

N. Figueiredo: Conceptualization, Writing – original draft, Investigation, Data curation. **D. Monteiro:** Conceptualization, Writing – review & editing, Funding acquisition, Supervision, Methodology. **F. Rodrigues:** Conceptualization, Data curation, Writing – review & editing, Funding acquisition, Supervision, Methodology.

Declaration of competing interest

A conflict of interest may exist when an author or the author's institution has a financial or other relationship with other people or organizations that may inappropriately influence the author's work. A conflict can be actual or potential. At the end of the text, under a subheading 'Disclosure Statement', all authors must disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three (3) years of beginning the work submitted that could inappropriately influence (bias) their work. Examples of potential conflicts of interest which should be disclosed include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jth.2022.101510.

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