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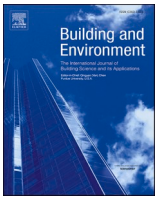

Views of older people on environmental sustainability: The development of the SustainABLE-16 Questionnaire

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ABSTRACT

There are over 1400 age-friendly cities and communities worldwide, and the efforts to create a better quality of life for older people progressively intersect with sustainability goals. The intentions and behaviours concerning sustainability among older are, however, not yet well understood. Therefore, there is a need for assessing these intentions and behaviours through the use of a transparently constructed and validated instrument which can be used to measures the construct of environmental sustainability among older people. The aim of this study is to develop a questionnaire measuring how older people view the theme of environmental sustainability in their daily lives, with a focus on the built environment, providing full transparency and reproducibility. The process of development and validation of the SustainABLE-16 Questionnaire followed the COSMIN protocol, and has been conducted in five phases. This rigorous process has resulted in a valid, psychometrically sound, comprehensive 16-item questionnaire. This instrument can be applied to assess older people's beliefs, behaviours and financial aspects regarding environmental sustainability in their lives. The SustainABLE-16 Questionnaire was created in Dutch and in British English.

1. Introduction

Since 2007, the World Health Organization (WHO) has been providing guidance to cities and communities around the world to take steps towards becoming more age-friendly and foster healthy and active ageing [1]. The WHO Global Network for Age-friendly Cities and Communities was established in 2010 to connect cities, communities and organisations all over the world, and currently includes 1445 cities and communities in 51 countries, covering over 300 million people worldwide [2]. The network's mission is to stimulate and enable cities and communities to become increasingly age-friendly.

In a recent paper by van Hoof et al. [3], it was explored how the age-friendly cities and communities movement interacts with other agendas, and it was found that the age-friendly agenda also has the potential to intersect with the sustainability agenda. These interactions with sustainability were further narrated by van Hoof [4], who cited the work by Marston and van Hoof [5], Marston et al. [6], Pillemer et al. [7] and Wright and Lund's [8]. All these studies call - to a certain extent - for studies on ageing and sustainability, environmental stewardship, and ecological footprint. Sustainability can be understood in terms of three dimensions, namely environmental, economic and social sustainability [9]. This paper focuses only on environmental sustainability (as a long-term goal) [10], and the closely related concept of sustainable development, which refers to the plethora of processes and pathways to achieve sustainability.

As described in detail by van Hoof [4], the WHO [11] touched upon the nexus between age-friendly cities and communities and sustainability. It is, however, unsure to what extent the report mentioned sustainability with regard to environmental sustainability, though the relationship becomes more explicit in 2018. The WHO [12] referred

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explicitly to the Sustainable Development Goals (SDGs) and stated that 15 out of 17 are relevant to ageing. Various studies [13–18] dealt with population ageing and sustainability, stressing both the negative and the positive aspects of this demographic trend. As outlined by van Hoof [4], the need for a more sustainable society is further exacerbated by practical issues such as the rising fuel and transportation costs and the cost-of-living crisis in the European Union that were skyrocketing in 2022, the persistent phenomenon of fuel poverty, and, simultaneously, the wish for air-conditioning in hot summers. At the same time, the European Union has drafted ambitious plans for a green transition of society.

Considering the link to the concept of sustainable development, the European Union's (EU) policies and strategies were influenced by the Brundtland Report "Our Common Future" published by the United Nations World Commission on Environment and Development in 1987 [19]. From that time on European perspective directly referred to sustainability as a desired pattern of development. In 1992, the EU ratified the Maastricht Treaty, which named sustainable development as one of the treaty's goals [20]. In 2001, the EU adopted the European Sustainable Development Strategy, which established a framework for sustainable development across all policy sectors. In 2005, the EU adopted the Lisbon Strategy, which mentioned sustainable development as a main pattern of European actions, however, with the election of the new Commission in 2004, work on the EU Sustainable Development Strategy review got under way. The European Council decided in March 2005 that the revised Lisbon Strategy should be seen in the larger context of sustainable development, and that the new, more thorough, and more ambitious Sustainable Development Strategy should include targets, indicators, and a reliable monitoring process, as well as fully integrate the internal and external dimensions [21]. After the UN adopted the 2030 Agenda for Sustainable Development (with 17 Sustainable Development Goals, SDGs) in 2015, the EU has committed to implementing the SDGs and has integrated them into its policies and strategies [22]. Recent document in that regard in EU is the European Green Deal launched in 2019. It is a comprehensive plan to make the EU's economy sustainable and climate-neutral by 2050. Initiatives to lower greenhouse gas emissions, promote renewable energy, boost energy efficiency, protect biodiversity, and support sustainable agriculture and fisheries are all part of the Green Deal [23].

Given the increasing importance of sustainability as a part of one's daily routine and life in countries in the European Union, including the Netherlands, there is a need to establish a basic understanding of the attitudes, behaviours and culture among older people. Then again, because "*older people know best what they need, they are at the centre of any effort to create a more age-friendly world*" [24]. This also applies to these aforementioned pro-environmental attitudes, behaviours and cultures among older people. In order to measure pro-environmental attitudes and behaviours, a broad spectrum of hundreds of measurement scales have been developed and validated although looking for a single robust scale having good measurement properties has proved to be overwhelming [25,26]. Moreover, these developed instruments lack transparency of (several phases of) the development and validation process, they often do not measure the construct of a sustainable lifestyle as a whole given the growing awareness of environmental sustainability amongst the general public [27–29], the methodological rigour in the development process can be questioned, influencing the reliability, validity and usability of these instruments or validity and reliability results are disappointing. Nkaizirwa et al. [25] also concluded that all existing scales such as the often-used Pro-Environmental Attitudes Questionnaire (PEAQ) by Félonneau and Becker [30] and the Environmental Awareness Scale by Blok et al. [31] focus mainly on measuring environmental attitudes and behaviours of adults with limited to none consideration of older adults.

With no robust instruments specifically targeting older adults described in current literature [25] and in light of future perspectives for sustainable and ecological urban design and development [32–35], it is timely to have an instrument that assesses behaviours, drivers and other factors related to sustainability among older people. To do so, we aim to systematically develop [36] a questionnaire measuring how older people view the theme of environmental sustainability in their daily lives, with a focus on the built environment, starting in the Netherlands.

2. Methods and materials

The SustainABLE-16 Questionnaire for measuring how older people think about the concept of environmental sustainability was developed systematically, following the criteria stated by the COnsensus-based Standards for selection of health Measurement INstruments (COSMIN) [37]. The COSMIN criteria have been selected because they provide a standardised guideline for evaluating measurement properties, including clear definitions and terminology, which promotes the transparent and consistent reporting of results, increasing the comparability across studies, and allowing for a better synthesis of research findings. Five consecutive phases of COSMIN have been followed: (1) the development of the conceptual model; (2) the initial (qualitative) validation; (3) the psychometric validation; (4) testing the reliability and validity; and (5) the translation phase (Fig. 1).

2.1. Phase 1

The goal of the first phase was to construct the theoretical basis for a conceptual model underlying the questionnaire [38] on how older people view the theme of environmental sustainability in their daily lives. Relevant models and themes that featured in publications (books, guides and articles) released after 2007 (the launch of the Global Guide by the WHO [1]) were summarised and assessed by the research team (J.v.H.;J.K.K.;J.D.). This research team was characterised by its diversity, and its members were complementary in regard to the respective field of expertise. J.v.H. has a background in housing, engineering and social work, and was responsible for the content of the questionnaire. For the purpose of this work, J.v.H. is familiar with the age-friendly literature and discourse in The Netherlands, Poland and Romania (such as [39–41]), which is relevant given that this study was conducted as part of a larger European research project with partners from these three countries. J.K.K. has a background in environmental engineering, sustainability and spatial management, and is the leader of the Sustainable Cities and Regions Group at his university, which has a special interest in researching an ageing society. J.D. has a background in nursing, health sciences and gerontology. He was also responsible for the content of the questionnaire from the perspective of quality of life. He has extensive experience in developing and validating measurement instruments, including the Knowledge about older patients' quiz (KOP-Q) [42–44] and the Age-Friendly Cities and Communities Questionnaire (AFCCQ) [45]. All three authors have published on either age-friendly cities and/or environmental sustainability.

As there are many types of models concerning sustainability that span many aspects of the phenomenon, and of which none focuses on the aspects of population ageing, consensus was reached on a broad theoretical basis that was found in five papers [3,7,15,17,46]. The research team found the contents of these papers fit the best with the objective of the study. Together, these studies identified several main research topics in the field, namely (1) energy consumption and management, (2) environmental sustainability in the built environment, (3) application of sustainable technologies, and (4) other sustainable behaviours (including transportation and food), attitudes and beliefs (including vulnerability and resilience), and sustainability literacy and communication. Based on the outcomes of the development and application of the Age-Friendly Cities and Communities Questionnaire [45,47], which have shown the significance of financial aspects in the daily lives of older people, finance has been incorporated as an additional element.

Based on the conceptual model, the next step was to generate items [38]. Most items (a total of 39) were based on the results and examples

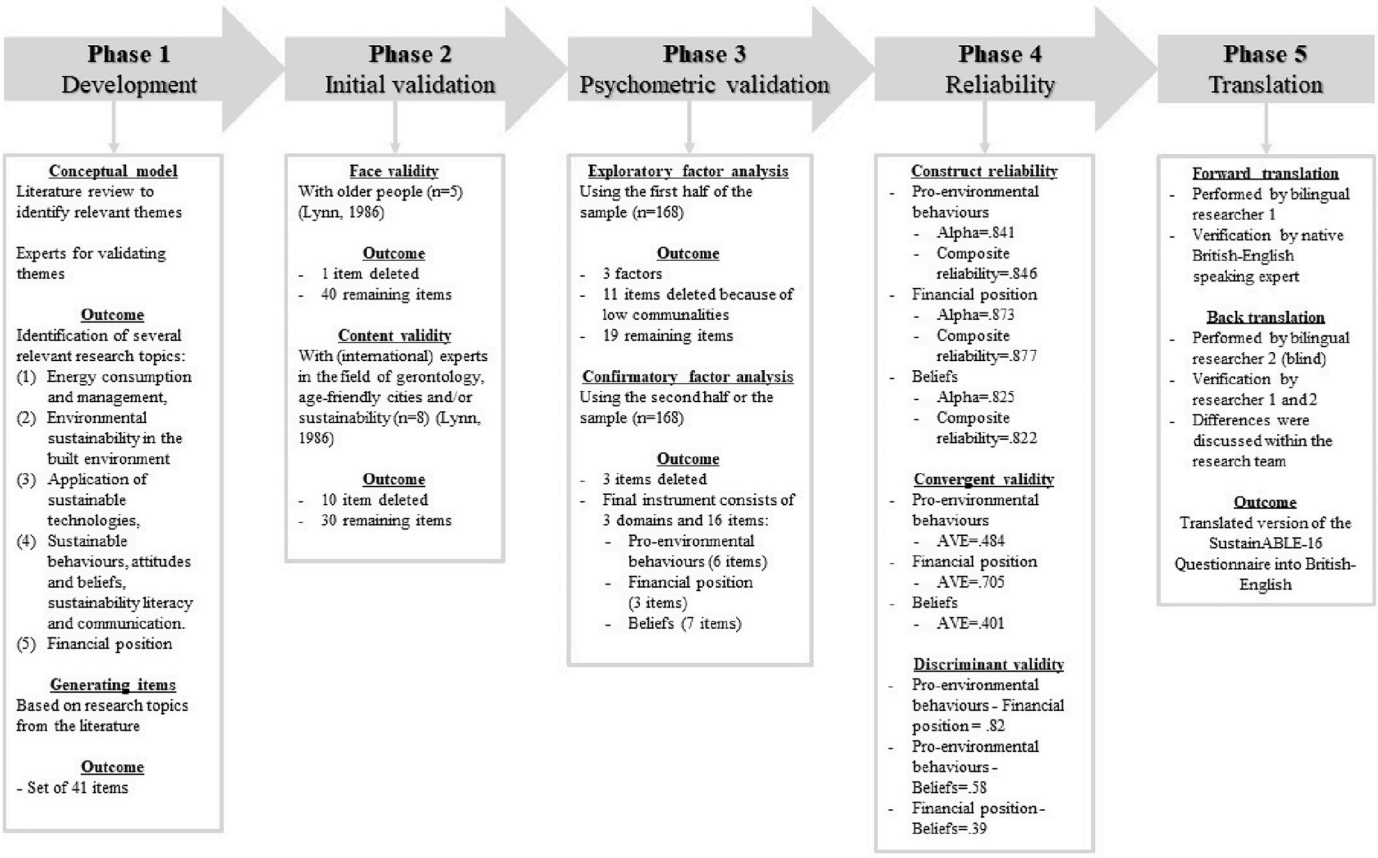

Fig. 1. Flowchart representing the phases and steps for developing the SustainABLE-16 Questionnaire.

described in the literature underlying the main themes in our conceptual model. Because the age-friendly literature was an important starting point for the development of the questionnaire, the "Checklist of Essential Features of Age-Friendly Cities" [48] was consulted, though it did not provide sufficient basis for the development as it did not mention aspects of sustainability. The Global Guide [1] only touched upon the cleanliness of a city, and enforcement of regulations to limit noise levels and unpleasant or harmful odours in public spaces under the domain of Outdoor Spaces and Buildings, which led to the generation of one additional item on cleanliness. The Liveability Index by the American Association of Retired Persons AARP) [49] considers several aspects of the environment, such as clear air and water, but only to a limited degree. This American index led to the generation of one additional item on air quality.

2.2. Phase 2

Phase 2 concerns the face validity, understandability and content validity, which were assessed simultaneously in order to come to a definitive selection of items. This definitive selection should represent the construct in an adequate manner [38]. Face validity and content validity were assessed using a quantification method [50]. For face validation a total of five older persons were contacted to participate in accordance with the literature [51]. These older people received an e-mail invitation with a request to rate the relevance of the SustainABLE-16 Questionnaire items regarding construct, study population, and purpose. For this step, rating took place using a four-point Likert scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant). The comprehensiveness was assessed by asking the older people to judge from their own perspective if the items covered the entire construct of sustainability. Finally, participants were asked if they understood all the questions, if not, indicate the questions which they experienced as difficult in language (understandability). To assess the content validity, an international group of experts having a doctoral degree and a track record in the field of age-friendly cities, gerontology, ageing-in-place and/or sustainability and the built environment were invited via e-mail to participate in Phase 2. Individual experts were asked to appraise the relevance of the items with respect to the construct, study population, and purpose, using the same four-point Likert scale. Again, comprehensiveness was assessed by asking the experts whether the proposed items reflected the construct of environmental sustainability well, and if they potentially missed additional items or themes.

2.2.1. Statistical analyses in phase 2

All data were analysed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). The Item Content Validity Index (I-CVI) was computed for all 41 items in order to assess both face and content validity. Content validity [50,51] is defined as the proportion of experts who rate the content as valid, in order words, when the items receive a relevance rating of 3 or 4. An item is considered to be excellent when the I-CVI value is 0.78 or higher [50,51]. Items which receive a score below this threshold are excluded from further analysis. All I-CVI values are averaged as part of a complete instrument validation in order to compute a Scale Content Validity Index (S-CVIave). If this index is 0.90 or higher, the instrument validation is considered to be excellent [51].

2.3. Phase 3

The next phase concerns the statistically evaluation of the validity of the SustainABLE-16 Questionnaire. Because a hypothesis about the nature of the underlying factor structure was missing, the team set out by

conducting an Exploratory Factor Analysis (EFA). EFA can be used to identify the underlying factor structure of a questionnaire [52]. The factor structure that resulted from the EFA was further tested through a Confirmatory Factor Analysis (CFA). A CFA enabled the team to test the hypotheses about which items measured which latent factors in an explicit manner. The CFA also provided more robust evidence concerning the overall validity of the fit of the tested model with the data to test whether the new instrument accurately measured what it claimed to assess. For the investigation of the validity of the SustainABLE-16 Questionnaire, the dataset was randomly split in half (n = 168 for each of the two subsets). The first subset was used for conducting an EFA, and the second subset was used for the CFA. Several studies [52–54] instruct researchers to use this approach to study the validity of a single survey administration, in particular when the collected sample is extensive enough that the subsets can be used to run multiple rounds of factor analyses. These two subsets were statistically tested to see whether there were significant differences in terms of demographic characteristics. The results indicated that they were not statistically different.

2.3.1. Data collection and participants

A representative sample of community-dwelling older people (65 years and over) were recruited from The Hague (Table 1). On January 2022, a total of 553.306 people were registered in The Hague (https://denhaag.incijfers.nl/jive), of which 82.762 (15%) were 65 years or older. From this group, around 95% live independently at home. The recruitment strategy followed that of van Hoof et al. [47]. This meant that the ratio between males and females was 45%–55%. Participants had to come from all boroughs of the city. A representative distribution was sought across the age cohorts (65–69 (~31%); 70–74 (~27%) and 75+ (~42%)). The sample also had to reflect the home ownership ratios in the municipality (58% were owned by the dweller, and 42% rented) [55].

Data collection was conducted by Dimensus, Breda, the Netherlands in November and December 2022. In total 16,000 persons were selected at random from a sample of 50,542 households of people aged 65+ who were registered in the municipal personal records database of the municipality of The Hague. After deletion of duplicates (multi-person households) at the address level, 1,582 people were contacted. An additional 10 participants were recruited through GetOud, The Hague, The Netherlands, through the so-called snowballing method, in order to get additional participants with a low level of literacy. A total of 396 people (25%) participated in this study. Listwise deletion was used if participants had missing scores on the sustainability questions (exclusion of 60 participants, which led a total of 336 participants for the psychometric validation of the questionnaire).

Table 1
Demographics of participants without missing values on sustainability items (total $n = 336$).

	n (%)
Sex	
Male	155 (47.7%)
Female	170 (52.3%)
Missing value	11 (3.3%)
Age	
Mean (SD)	74.7 (9.02)
65–69	59 (21.8%)
70–74	79 (29.2%)
75+	133 (49.1%)
Missing values	65
Born in the Netherlands (%) [a]	276 (84.7%)
Educational level (ISCED level)	
Low (level 0-3)	137 (40.8%)
Medium (level 4-5)	29 (8.6%)
High (level 6-8)	165 (49.1%)
Missing	5 (1.5%)
Years living in The Hague	
Mean (SD)	51.1 (24.5)
Type of dwelling	
Owner-occupant	192 (57.8%)
Social housing	87 (26.2%)
Private rent	53 (16.0%)
Missing	4 (1.2%)
Living together with a partner (%)	180 (54.1%)
Receiving care (%)	81 (24.3%)
Living with one or more chronic conditions (%)	119 (36.0%)
Using a wheeler walker or wheelchair (%)	60 (18.2%)

[a] Denotes a potential migration background, including the (former) overseas territories of the Kingdom of the Netherlands.

2.3.2. Exploratory and confirmatory factor analyses

An exploratory factor analysis can help determine how well the items of an instrument align with latent factors. When there is no alignment or items are too identical in nature, items can be taken out. This, in turn, improves the overall quality of the instrument that is under development. First, the correlations among all items of the instrument were assessed in order to find out which items were related. Item variance and means were also examined. According to DeVellis [53], one should strive to have a relatively high item variance and a mean closer to the centre of the instrument's range. The number of latent factors was determined using scree plots [52] and parallel analysis, which helps to determine the number of factors. Thereafter, a maximum likelihood EFA was conducted using the oblimin rotation. Communalities and the loadings of each item were examined to identify those with low or cross-loadings following instructions by Tabachnick et al. [56] and Matsunaga [57]. Low or cross-loading items and items with low communalities (>0.40) were taken out one at a time.

Thereafter, the factor structure resulting from the EFA was tested using the CFA. First the variance to unity was set, and multiple fit indices were considered for the model fit. First the normed χ^2 was used for which a value below 2 is preferred, though values ranging from 2 to 5 are considered acceptable [58,59]. The Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) were also tested, and these indices should be 0.90 or higher [60]. Additionally, the root-mean squared residual (SRMR) was used, which should be lower than 0.08 for a good fit [61], as well as the root-mean square error of approximation (RMSEA) was tested. In regards to the RMSEA, a threshold of 0.01 or less should be obtained for excellent fit, 0.05 or less for good fit, and 0.08 for moderate fit [62]. At the same time, Hu and Bentler [61] stated a range of 0.05–0.10 for a moderate fit. The abovementioned values guided the process of model fit.

2.4. Phase 4

Construct reliability was assessed using both Cronbach's Alpha and the Composite Reliability. Taber [63] mentioned that Cronbach's Alpha should be higher than 0.70 and the same value is advised as a benchmark for composite reliabilities [64]. The convergent validity of instrument items was estimated using the Average Variance Extracted (AVE) measure, which should exceed 0.50 for every construct [65]. Discriminant validity was calculated using both the Fornell and Larcker criterion [65] which compares the amount of variance captured by the constructs and the shared variance with the other constructs (meaning the level of square root of the AVE for each construct should be greater than the correlation involving the constructs). Moreover, the Heterotrait-Monotrait (HTMT) ratio was assessed for discriminant validity which has to be lower than 0.85 [66].

2.5. Phase 5: Instrument translation

For instrument translation, the forward-backward procedure was followed [67]. All 41 items were translated from Dutch to British English independently by a native Dutch speaking researcher (JvH) doing the forward translation. This translation was verified by an independent

Table 2
Item communalities and results of the final Exploratory Factor Analysis.

Item		Communality	Factor 1	Factor 2	Factor 3
1	I can pay my energy bills.	.610		-.771	
2	I conduct energy and water-saving measures at home	.599			.671
3	I sometimes turn off lighting or equipment because of the costs	.684			.874
4	I sometimes turn off lighting or equipment for the sake of the environment.	.694			.670
5	I deliberately reduce the heating in winter because of the costs.	.714			.861
6	I deliberately reduce the heating in winter for the sake of the environment.	.698			.630
7	When keeping my home cool during periods of heat, I am considerate of costs.	.544			.725
8	When keeping my home cool during the summer or heatwaves, I am conscious of the environment.	.616			.575
9 [a]	I know what to do in and around my home to save energy	.301			
11 [a]	I have the option to implement energy-saving measures into my home.	.286			
12	I have the financial means to implement energy-saving measures in my home.	.685		-.817	
13	I am concerned about climate change.	.630	.750		
14	I try to save water as much as I can.	.454			.444
15 [a]	I can stay comfortable on extremely hot summer days.	.308			
19	I separate my household waste where I can (e.g., recycling)	.405	.508		
20	I think it is important to use sustainable energy.	.610	.664		
21	I have sufficient financial means to live an environmentally conscious life.	.749		-.778	
22	I have implemented measures myself to lead a more sustainable life.	.635	.615		
23 [a]	I am conscious of food waste; I don't throw anything away.	.286			
25 [a]	I would like to have more of a say in policy on sustainability measures.	.183			
27 [a]	I find the support measures (such as subsidies, assistance, and technical advice) sufficient.	.179			
28	My income is under pressure due to sustainability measures from the government.	.599		-.767	
29 [a]	People who pollute more should pay more for it.	.286			
30 [a]	If I had the opportunity, I would like to generate sustainable energy at home myself.	.316			
31 [a]	I would rather live in a smaller home from an environmental point of view.	.222			
33 [a]	I use public transport for the sake of the environment.	.345			
36 [a]	I have plenty of opportunities to relax in green space or in nature (e.g., local parks)	.247			
38	I am willing to eat less or no meat to improve the environment.	.538	.657		
39	I am willing to eat seasonal foods more frequently to improve the environment.	.553	.733		
41	I believe that biodiversity affects my quality of life.	.617	.764		

[a] denotes items with low communalities (<.40) that were excluded from the exploratory factor analysis.

native British English-speaking expert in the field of gerontology and gerontechnology. Then, for backward translation, the main researcher (JD) translated the items back into the Dutch language. JD did a blind translation. Thereafter, the original items in Dutch were compared with the back-translated version by JD and JvH. Differences were discussed by the research team in order to reach consensus on the final version of the translated instrument.

2.6. Ethical and privacy considerations

This study presents the results of the Netherlands being part of an international consortium of the City&Co project with partners from Poland and Romania. Therefore, certification of Ethical Acceptability for Research Involving Human Subjects was obtained from the director of the Ethic Committee at the National University of Political Studies and Public Administration (SNSPA), associate professor Ion Stavre, on 23 May 2022. This study also followed the Medical Research Involving Human Subjects Act of the Netherlands [68]. Participants consented to their participation by filling out the survey.

For the purpose of the study, data processing agreements had been signed between the municipality, the university and the research agency. These agreements followed the recommendations from a legitimacy review that was made for the consortium by two independent lawyers familiar with European privacy and data protection regulations.

3. Results

3.1. Phase 1

A total of 41 items were developed for the different domains derived from the literature. Supplementary Table 1 (Table S1) provides an overview of all 41 items, and the reasons for the exclusion of a total of 25 items in the different phases of the development process.

3.2. Phase 2

A minimum number of 5 respondents three females and two males having a mean age of 73.4 (range 62–82) appraised the items in terms of face validity. Of the 41 initial items, only one item (item 24) was excluded from the initial set of items after the assessment of face validity scores (Table S1). The reason for its deletion was its low I-CVI score of 0.40 (i.e., lower than 0.78). Older persons understood all items and had no recommendations for additional questions. In total, nine (international) experts participated in this step (five from the Netherlands, two from the United Kingdom, one from Germany, and one from Australia). Five experts were female and three were male. Of the 40 remaining items, a total of ten items were deleted in this step after assessment of the outcomes of the content validity (Table S1). The S-CVIave of the remaining 30 items was 0.86, which fell within the desired range 0.78–1.00. Several suggestions were made by the experts, and the research team discussed these comments. As most of these suggestions were already incorporated in the existing items or did not align with the purpose of the scale, namely, to measure older people's view regarding the theme of sustainability in their daily lives. Therefore, no further changes were made to the set of items.

3.3. Phase 3

3.3.1. Exploratory factor analysis

For the 30 remaining items, the scree plot method identified a total of four factors. Simultaneously, the parallel analysis identified three factors. The research team decided to go with a total of three factors, as this number had the best fit with the conceptual model. Items with low communalities (<0.40) were removed from the list of items (n = 11) (Table 2). Although an item's communality should ideally be 0.80 or over, a range between 0.40 and 0.70 is rather common [69]. A total of 19 items were kept, as these items had loadings ranging from 0.44 to 0.87 (above the cut-off value of <0.32). Also, there were no cross-loadings.

3.3.2. Confirmatory factor analysis

The CFA showed that the three-factor model of the instrument did not fit the data well, which could be ascribed to low factor loadings. Therefore, several models were run to maximise the model fit with the data (Table 3). Initially, all items with factor loadings <0.50 were excluded (model 2). This was followed by a test for problematic standardised residual covariances and error terms with high covariances, error terms were correlated if necessary to increase model fit (model 3). Because the SRMR did not meet adequate fit measures, the item with the lowest factor loading was excluded in model 4. This resulted in the final model for the Netherlands with an adequate fit (Fig. 2). This model demonstrated a value of the normed χ^2 of 1.823, which indicates a good fit. Values of the robust CFI (0.941) and the robust TLI (0.923) both exceeded the 0.9 threshold [60]. The RMSEA was 0.07, which is slightly lower than the required 0.08 (threshold for moderate fit [62]). The robust SRMR was 0.0777, which is also slightly below 0.08 but nevertheless a good fit [61]. The estimated covariance paths between the factors were all lower than the suggested 0.85 cut-off value. The final model (model 4) had a good fit with the second subset. Finally, we tested a model with higher constrains (factor loadings <0.60 were excluded), leading to a model with eight items having high loadings (>0.70) on the factors, without correlated error terms with high covariances, and with excellent fit indices. This model may eventually be more adequate for cross-cultural validation purposes, as fit indices are well over the needed thresholds. Fig. 1 shows the final (acceptable) model (model 4) for the Netherlands. Supplementary Fig. S1 presents model 5.

3.4. Phase 4

Construct validity was established for every construct in the study (Table 4). The values of Cronbach's Alpha for each of the constructs were over 0.80, and therefore considered to be robust and reliable [63]. Composite reliabilities ranged from 0.822 to 0.877, which is well above the 0.70 benchmark [64]. The AVE values were above the threshold of 0.50 for the construct of "Financial position", but not for the two other constructs of "Pro-environmental behaviours" and "Beliefs". However, as the composite reliability was well over the required minimum value for both constructs, we conclude that they can be considered valid (Table 4).

Discriminant validity was obtained, as the square root of AVE for all three constructs was greater than the correlations with the other constructs under study. Moreover, the HTMT ratios were all lower than 0.85. Results of the discriminant validity analysis are presented in Table 5.

3.5. Phase 5

Overall, the forward translation was correctly performed by a bilingual researcher (JvH). However, several changes were made by the native British English-expert, for instance, the word "consciously" was changed to "deliberately". The final product of the back translation was quite similar to the original items in Dutch. At times, items were translated rather loosely and some word choices did not fit the original meaning completely. Consensus was reached among members of the research team that no further changes were required to the final version of the back translation. Cultural issues were not taken into consideration in this phase of the development process. The Dutch and British English versions of the instrument can be found in Supplementary Tables 2 and 3

The minimum and maximum numbers of points for each of the domains vary as the number of questions asked for each of the domain varies, too. These scores can be divided into eight quarters, which represent how older people feel and behave. In order to allow for a straightforward interpretation of results, the use of a colour scheme principle is advised (Supplementary Table S2 and Supplementary Table S3) in addition to a numerical score for each of the three domains. The eight quarters correspond to eight coloured zones, which roughly follow the design of a traffic light. Scores in the red zone mean people have more negative attitudes, and scores in the green zone indicate the opposite. Slightly positive or negative scores are represented by a white colour. These colour codes also indicate a sense of urgency, and may help policy makers and other stakeholders to prioritise dedicated actions.

4. Discussion

The 16-item the SustainABLE-16 Questionnaire can be used to measure how older people view the theme of environmental sustainability in their daily lives, with a focus on the built environment. To date, such a validated tool did not exist, though alternatives with a poorer fit could be sought in the broad spectrum of hundreds of measurement scales [25] that exclude the attitudes and behaviours of older adults. The SustainABLE-16 Questionnaire is the first validated tool of its kind, which can be applied for a quick but rigorous quantitative assessment of how older people view aspects of environmental sustainability. In addition to the application of the SustainABLE-16 Questionnaire, further qualitative data could be gathered by and shared with researchers, environmental campaigners or policy makers alike. The questionnaire could be used to monitor the progress (or decline) of sustainable views among older people (in a longitudinal study design), and help increase the potential impact of social (action) programmes or environmental policies. A particular strength of the SustainABLE-16 Questionnaire is that it enables researchers to gather data among older people themselves. Because of the three factors identified, financial aspects, pro-environmental behaviours and beliefs, the outcomes of the survey may help to understand which groups are willing (and unwilling) to pursue a more sustainable lifestyle, whether or not they can afford, and whether living a sustainable lifestyle goes best if the items relating to pro-environmental beliefs of older people are answered positively. Policy makers may also ask for additional research and actions in the fields with low scores, and adjust their interventions towards specific target groups, depending on the outcomes. This is most essential benefit of this new questionnaire. The questionnaire could also help to

Table 3
Models maximising the model fit with the data.

Model	Normed χ^2	Comparative Fit Index (CFI)	Tucker Lewis Index (TLI)	Root-Mean Squared Residual (SRMR)	Root-Mean Square Error of Approximation (RMSEA)
Model 1 (19 variables)	3.260	.763	.728	.0920	.116
Model 2 (17 variables) Exclusion of items with loadings <.50	3.349	.802	.763	.0904	.119
Model 3 (17 variables) Correlate error terms with high covariances	1.889	.930	.911	.0814	.073
Model 4 (16 variables)	**1.823**	**.941**	**.923**	**.0777**	**.070**
Model 5 (8 variables) Exclusion items with loadings <.70	1.305	.991	.986	.0309	.043

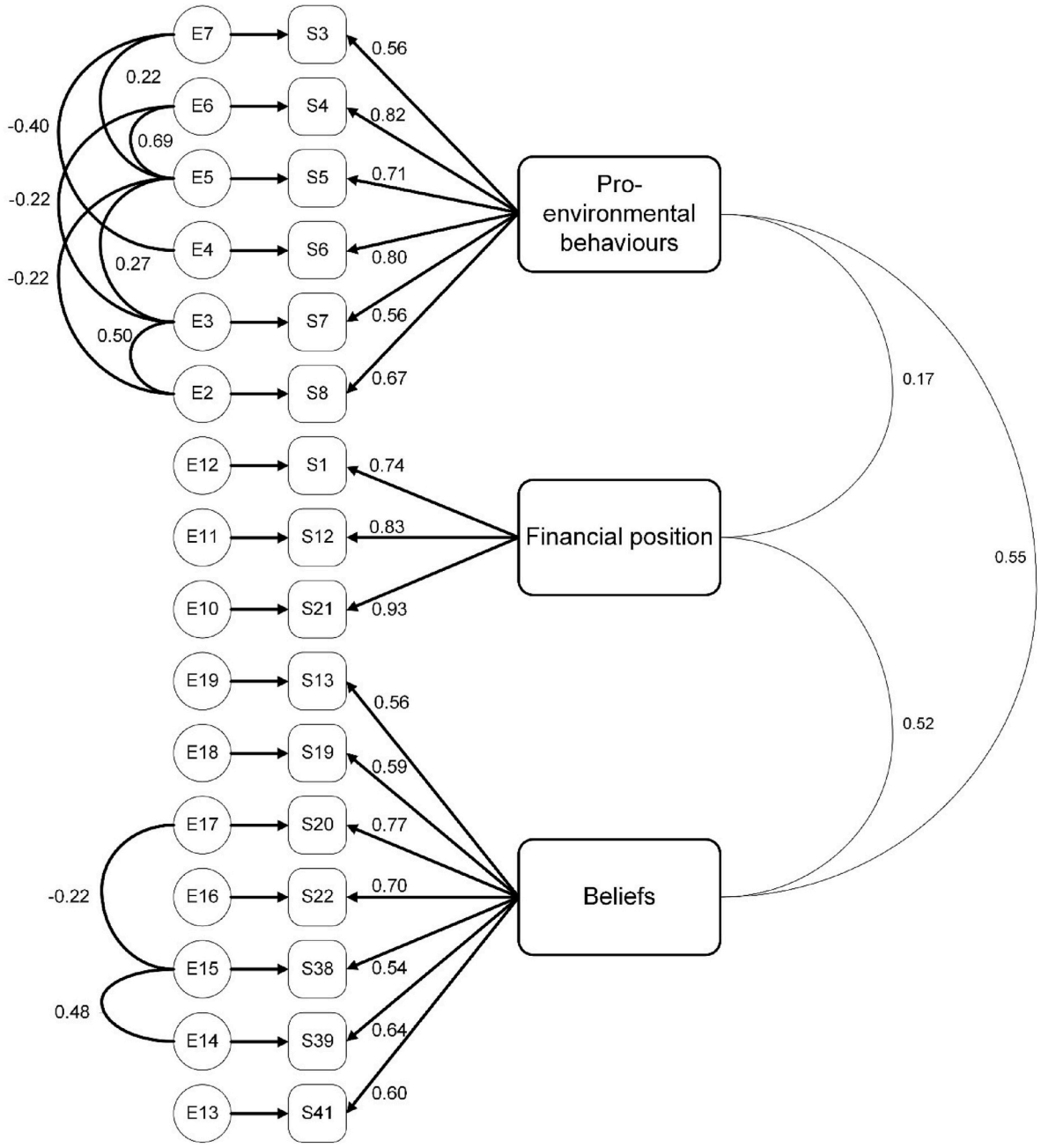

Fig. 2. Model of the final confirmatory factor analysis.

Table 4
Loadings, reliability, and convergent validity.

Items	Cronbach's Alpha	Composite reliability	Average Variance Extracted
Pro-environmental behaviours	.841	.846	.484
Financial position	.873	.877	.705
Beliefs	.825	.822	.401

gain a deeper understanding, also among local governments and city councils, of the heterogeneity among older people in our societies. Findings from the development of the Age-Friendly Cities and Communities Questionnaire (AFCCQ) and its use in a survey in The Hague showed that there are many different views among particular groups of older people in the city and that the questionnaire can account for these

Table 5
Discriminant validity using both Fornell and Larcker criterion [65] and HTMT ratio [66].

	Pro-environmental behaviours	Financial position	Beliefs
Fornell and Larcker criterion			
Pro-environmental behaviours	***0.695***		
Financial position	0.168	***0.84***	
Beliefs	0.555	0.516	***0.634***
Heterotrait-Monotrait (HTMT) ratio			
Pro-environmental behaviours			
Financial position	0.82		
Beliefs	0.58	0.39	

differences [45,47]. Such differences were most prominent concerning socio-economic backgrounds (financial aspects) and health status (impaired mobility and chronic conditions), and this seems to be the case with views on sustainability too given the great significance of questions pertaining to financial aspects which were retained after both qualitative and quantitative procedures.

One critical aspect that remains the subject of future work is the unanswered question whether there is really any difference on the perception of sustainability between older people (65 and over) versus those younger than 65. Would someone who turned 65 all of the sudden have a different perspective or perception on this than a year or five years before that? If someone is environmentally conscious when they are younger, would their beliefs, attitudes and behaviours become different as they get older? Or would people become environmentally more conscious as soon as they turn 65? These intergenerational differences could be a future research subject. Based on the underlying model of the SustainABLE-16 Questionnaire, older people may have different views on environmental sustainability based on (1) their income (i.e., limited income may make them more conscious about what they are doing), and (2) their health (people with chronic condition may choose to use more energy in order to maintain higher indoor temperatures) (see, for instance, Bennetts et al. [70] and Soebarto et al. [71]). As the questionnaire does not include questions that can reflect this possible change in behaviours and attitudes when reaching the age of 65 years, it may be important to present this questionnaire a number of times – before people enter the retirement age, then during early stage of retirement, and many years after. Or, when using the questionnaire in practice, ensure that the sample cohort ranges from early, mid to late stages of older age, as we might (or not) find that the answers change as people get much older. Additionally, the application of the questionnaire may be coupled with group discussions to find out the answer to the 'why' and 'how come' questions.

Another main questions that the authors have is whether the current SustainABLE-16 Questionnaire is applicable in ageing societies which are not based in the Netherlands. The Netherlands has a long-standing tradition of sustainability that is propagated through governmental bodies and non-governmental organisations. This position as a sustainable frontrunner may have impacted the construct of the questionnaire and its constituting items, as both older people and experts are well-acquainted to a pro-environmental discourse in politics, in the media and in society. This is why four international experts (based in Germany, the United Kingdom and Australia) were consulted in order to critically appraise all 41 items and potentially delete any item that may have been too specific for the context of the Netherlands. The followed procedure could have potential advantages for future cross-cultural validation studies, which aim to make the questionnaire applicable to use in other countries with different cultures, especially in countries where older people are less well-off financially, such as Romania and Poland.

There are some limitations and considerations that should also be discussed. The representativeness of the sample of community-dwelling older people is subject to discussion, as older people with strong positive or negative views are more likely to participate in surveys and resubmit filled out response forms. Given the primary focus on the psychometric validation of the SustainABLE-16 Questionnaire, this is acceptable. Also, for the initial translation into British English, the well-known steps of the forward-backward procedure were followed. However, this study did not work with two independent translators in each step. Therefore, it is recommended to further test the current British English version in terms of language and cultural appropriateness before starting data collection on a large scale.

Regarding the sample size, there is large corpus of literature describing the appropriate sample size to use when conducting a factor analysis for the purpose of making a validated questionnaire. Mundfrom et al. [72] came up with minimum sample sizes which range from 3 to 20 times the number of items, and with absolute numbers ranging from 100 to over 1000 respondents. This study met the criteria mentioned with a ratio of 1:10.5 and an absolute number of 168 participants in both the EFA and CFA analyses.

As the SustainABLE-16 Questionnaire is rooted in the available scientific and grey literature on age-friendly cities, it may be used by the WHO to incorporate sustainability and the three factors found in this study in future reports on age-friendly cities and the assessment of healthy ageing. In previous reports on age-friendly cities and communities, the knowledge base was rather slim. WHO [11] reported that walkability, proximity to and accessibility of transportation stops, the engagement in socio-cultural activity, emergency preparedness, as well as the availability of social and health services, are indirectly related to sustainability. WHO [12, p.1] further highlighted the need to improve the fit between people's needs and the environments in which they live, and stressed the importance of sustainability in the environment. This is of particular importance, as the impact of population ageing on residential energy demand has been subject of scientific study for decades [73–78], and their participation in residential conservation programmes and efforts has been described from many perspectives [79–83]. The need for energy conservation stems not only from the need for sustainability in the built environment but also from a financial and social perspectives, namely that of the persistent phenomena of fuel poverty and energy vulnerability and their impact on well-being and quality of life, one's financial situation and stress, thermal comfort, and social interactions [4,84–91]. Fuel poverty is a serious problem in many European countries, both in terms of inadequate indoor heating as well as indoor cooling, with unfavourable repercussions for health, well-being and productivity [92[]]. Through the analysis of data from Poland, Czechia, Hungary and North Macedonia, on summertime energy poverty, Thomson et al[.]92 identified the impetuses of household vulnerability with, and risks of exposures to, excessive indoor heat and explored the connections with energy poverty. In another study, Chard and Walke[ ]]93 found that many people display day-to-day coping mechanisms in order to get by and control the energy bills. Thomson et al[ ]]94 stated that because of its culturally sensitive nature and being a private condition, assessing energy poverty is a difficult endeavour, which is further hindered by its temporal and spatial dynamics. The limited availability of appropriate indicators, and lack of conceptualisation of how to measure energy poverty, are a further complication. The new SustainABLE-16 Questionnaire may help to develop a better understanding of energy conservation practices and fuel poverty among older people, as both behavioural and cost aspects are covered. It may also identify which older people need certain approaches, whether it is additional information, financial means, or other forms of support, or whether older people do not have the will to engage in more sustainable lifestyles.

The SustainABLE-16 Questionnaire can be used to promote the eco-social transition of society, a movement which is described in detail by Matthies and Närhi [95]. Global ecological (environmental) social work should go together with strengthening the environmental paradigm in social work and social policy by undertaking further investigation on theoretical and conceptual elucidation.

5. Conclusions

This study resulted in a valid, psychometrically sound, comprehensive 16-item instrument.

The SustainABLE-16 Questionnaire covers three relevant domains, namely financial position, pro-environmental behaviours and beliefs. The SustainABLE-16 Questionnaire allows practitioners and researchers to capture how older people view the theme of environmental sustainability in their daily lives in a quantitative manner. Nonetheless, a process of cross-cultural validation needs to be undertaken before the SustainABLE-16 Questionnaire is used in other countries and cities, albeit as a part of a broader assessment of the age-friendliness of a city or community.

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CRediT authorship contribution statement

Jeroen Dikken: Writing – original draft, Validation, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jan K. Kazak:** Writing – review & editing, Writing – original draft, Project administration, Funding acquisition, Formal analysis, Conceptualization. **Veronica Soebarto:** Writing – review & editing, Investigation, Formal analysis, Conceptualization. **Joost van Hoof:** Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

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