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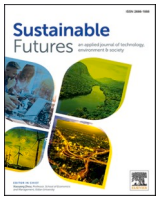

Testing the validity of SustainABLE-16 and SustainABLE-8 Questionnaires to assess the views of older people in Australia on environmental sustainability

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ABSTRACT

Older people have an important role to play in achieving environmental sustainability; however, studies to investigate their intentions and behaviours to achieve sustainability are scarce. To respond to this gap in knowledge, the SustainABLE-16 tool has been developed to measure how older people view environmental sustainability. The tool has been validated in Poland, Romania, North Macedonia and Israel. This paper presents a further validation of SustainABLE-16 in South Australia, involving 147 older people. The results show that, similar to the previous validations, when applied in South Australia the full version of SustainABLe-16 did not meet internationally-recognised fit requirements; however, the shorter version, SustainABLE-8, is shown to be a reliable and valid measure for use in this context. With SustainABLE-8, the three latent constructs – Pro-environmental behaviours, Financial position, and Beliefs – were found to have strong factors loadings, indicating that the observed variables reliably represented their respective latent constructs. The results also showed that among the respondents there was a strong association between Pro-environmental behaviours and Beliefs; however, Pro-environmental behaviours were found to have a weak correlation with Financial position. While SustainABLE-8 has been shown to be a valid tool for use in an Australian context, further Australian validations are required particularly with more diverse samples, including older people with lower socio-economic status and culturally and linguistically diverse backgrounds.

1. Introduction

Environment sustainability is understood as a state where natural ecosystems and resources are preserved and restored to support the health and wellbeing of people both at the present time and in the future [1]. Critical to achieving environmental sustainability is the minimisation of carbon emissions from human activities, water conservation, waste minimization, and power generation from renewable sources. These actions go hand-in-hand with the goal of improving the quality of indoor and outdoor environments for better health and wellbeing [2]. Achieving environmental sustainability is the responsibility of all members of a society – younger and older. A recent study demonstrates that even older people have played a role, and can become more active players, in achieving environmental sustainability [3].

Alongside environmental sustainability, climate change has also become a pressing issue impacting all people but particularly older people because the possibility of people experiencing reduced health conditions increases as they become older, making them more vulnerable to the impacts of climate change [4,5]. With increasingly unpredictable and extreme weather conditions occurring outside usual climatic patterns, climate change has become a great concern to older people and policymakers alike. A study conducted in major cities in Australia 2021 to investigate the perceptions of people of various age groups about climate change revealed that 65 % of the older participants

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aged 65–74 years old and 51 % of those aged 74+ perceived climate change as 'very much a problem for them' [6]. Another study in New South Wales, Australia, found that over half of the older respondents perceived climate change as the predominant issue of concern [7].

Faced with these issues, older people do have an important role to respond responsibly. In fact, a study conducted in Queensland, Australia, showed older people are taking actions to reduce their carbon footprints, with the adoption of rooftop solar panels found to be positively correlated with age [8]. Elsewhere, studies have found that many older people changed their behaviour to minimise their carbon footprints through actions such as insulating their homes, applying lower setpoint temperatures in their thermostat in winter (for heating) or higher in summer (for cooling) or switching to using energy-efficient appliances [9–11].

As people age, they become more vulnerable to heat and cold [5] and temperatures that are either too high or too low can have significant impacts on morbidity and mortality among older people [12,13]. Ensuring that the living environment of older people provide suitable conditions without creating an economic burden to them is therefore critical. The Council on the Ageing (COTA) has called for Australian governments at all levels – federal, state and local – to seriously consider climate change issues and develop adequate policy responses to ensure a sustainable environment that is safe, secure, and equitable to all older Australians [14]. These calls for action reverberate strongly in the 2024 publication by the World Health Organization on the further operationalization of the Sustainable Development Goals for older people [15], which was also emphasised in a scoping review by Shevelkova et al [34].

How older people perceived environmental sustainability have been explored in many studies, including by Hu [9], and Wang et al [16]. Nonetheless, these studies are often conducted in upper-middle and high-income countries, meaning that the results may not represent the views of older people with different socio-cultural and economic backgrounds. Moreover, since sustainability challenges vary across regions, it cannot be assumed that findings from one country automatically apply to another. Triggered by the fact that there are >1700 cities and communities worldwide attempting to become age-friendly, a team of researchers (involving the authors) has developed and cross-culturally validated the SustainABLE-16 Questionnaire (and its derivative SustainABLE-8) [17–20] to assess older people's beliefs as well as actions regarding environmental sustainability and the financial ability and willingness to undertake these actions.

This paper reports a further validation of the SustainABLE-16 (and its derivative SustainABLE-8) questionnaire by applying it in an Australian context, focusing on South Australia as the first stage. The study was conducted by a research team that had also tested the validation of the Age-Friendly Cities and Communities Questionnaire (AFCCQ) in Australia [21]. The AFCCQ is an overarching tool for older people to assess the age-friendliness of cities and communities while SustainABLE-16 has a specific focus on assessing the environmental sustainability of cities and communities. The validation and application of these tools in different contexts globally responds to the increasing number of calls to integrate the age-friendly and sustainability agendas for our ageing societies [22,23].

2. Background

SustainABLE-16 was developed in The Netherlands by an international team including three of the authors of this paper [17], following a rigorous process, resulting in a 16-question questionnaire that is comprehensive and psychometrically sound. The tool was tested in community dwellings of older people in The Hague, Netherlands, and the results showed that the majority of the respondents responded positively towards environmental sustainability [18]. The results also showed that six distinct typologies of older people could be identified from the way they perceived environmental sustainability. Since being launched in 2023, this instrument has been applied in other countries (e.g. Romania, Poland, North Macedonia and Israel) to test its cross-cultural validity [19,20]. The results showed that, out of the 16 questions, only eight yielded meaningful and validated results, hence it is concluded that in these countries the shorter SustainABLE-8 questionnaire should instead be used. Through the establishment of measurement invariance, it was also concluded that results could be compared between these countries in a valid and meaningful way.

The initial development of SustainABLE-16 was conducted in five stages. The first stage included the construction of the theoretical basis for the conceptual model that underlies the questionnaire. This process resulted in 41 questions, written in the Dutch language. The second stage tested the face validity and understandability with five older people and content validity of those initial questions by involving nine internationally acknowledged academic experts to appraise the relevance of the items with respect to the construct, study population, and purpose. Results from this validation process were statistically analysed to calculate the Item Content Validity Index (I-CVI) of each question and the Scale Content Validity Index (S-CVI), which is the sum of the average of all I-CVI. An S-CVI of 0.90 or higher indicates the instrument validation to be excellent. This stage resulted in ten questions from the initial list being removed. In the third stage, the validity of the remaining questions was tested and statistically evaluated, by involving >300 older people who lived in The Hague. The results were analysed by using Explanatory and Confirmatory Factor Analyses, resulting in three questions being deleted. The remaining questions were categorised into pro-environmental behaviours (six questions), financial position (three questions) and beliefs (seven questions). In the fourth stage, further statistical analysis was conducted to test the construct reliability of the questionnaire using Cronbach's Alpha and the Composite Reliability. In the final stage, the questionnaire was translated into British English and verified by a British English-speaking expert in the field of gerontology and gerontechnology. The English translation was then translated back by another researcher in the team into Dutch, and the two Dutch versions were compared. Differences were discussed in order to reach consensus. The final version of SustainABLE-16 and the detailed process of its development are reported in Dikken et al [17].

3. Methodology

The validation process of SustainABLE-16 in Australia is summarised below.

3.1. Pre-evaluation

Prior to testing the validity of SustainABLE-16 with a wider context of older people in Australia, 10 older people living in Adelaide, South Australia, were invited to participate in a focus group to go through each question to ensure its readability and relevance to an Australian context. This focus group discussion confirmed the readability and relevance of all 16 questions, so no changes were made.

3.2. Participant recruitment and ethics

Following the pre-evaluation stage, calls to participate in the research to test the validity of SustainABLE-16 were posted in the digital WeekendPlus magazine, distributed via e-mail to >75,000 Seniors Card holders in South Australia. WeekendPlus is managed by the South Australian Government's Office for Ageing Well. Two calls were posted, in September and November 2024, resulting in 158 WeekendPlus readers recruited to the study.

Human research ethics approval was obtained from the Human Research Ethics Committee of the University of South Australia in February 2023 with Ethics Protocol number 205,241.

3.3. Survey tool and questionnaire

The SustainABLE-16 questionnaire was subsequently entered into an online survey platform (SurveyMonkey). Prior to answering the questionnaire, each participant was asked to enter their demographic information, including sex, year of birth, country of birth, level of highest education, suburb of residence, house tenure (owner-occupied, social housing or private rental property), living arrangement (live alone or with other(s), whether or not they receive care at home, whether or not they have chronic illness or condition, whether or not they use mobility supporting device (such as, walking stick, walker or wheelchair), and self-assessment of their quality of life (score from 0 to 10). See Table 1. The SustainABLE-16 questions are presented in Fig. 1. At the end of the questionnaire, one additional open-ended question was asked for people to make any comments on the topic ("Do you have any comments you want to make about environmental sustainability?").

3.4. Analysis: psychometric validation

Because the SustainABLE-16 was considered valid and reliable in the pre-evaluation phase, the following phase was conducted: (1) assessment of data adequacy and quality, and (2) test of the construct validity using Confirmatory Factor Analysis (CFA) based on the model proposed by Dikken et al [17] to assess how well the data fit the model. To do this, several statistical measures and threshold values for adequate fit were applied [24,25]:

- Normed Chi-square ratio (χ^2/df): a value of 5 or lower being acceptable [26]
- Comparative Fit Index (CFI): a value above 0.90 being acceptable.
- Tucker-Lewis Index (TLI): a value above 0.90 being acceptable.
- Standardised Root Mean Square Residual (SRMR): a value under 0.08 being acceptable.
- Root Mean Square Error of Approximation (RMSEA): a value under 0.08 being acceptable.

In addition to these global fit criteria, we further evaluated the measurement model by reporting item-level standardised loadings (λ), standard errors (SE), and critical ratios (CR), computing factor-level Average Variance Extracted (AVE) and testing discriminant validity using the Fornell–Larcker criterion alongside inspection of inter-factor correlations (see Table 2). To verify internal consistency, composite reliability was computed, with scores above 0.70 deemed appropriate for ensuring measurement reliability [27]. All CFA procedures were conducted using IBM SPSS Amos version 28.0 [28].

Table 1
Demographic questions for SustainABLE-16.

1. What is your sex?	Male	Female	
2. What is your year of birth?	Year of birth		
3. In which country were you born?	Country name		
4. What is the highest type of education you have received?	Tertiary | secondary | primary | never went to school		
5. In which neighbourhood do you live? what is your postcode?			
6. How many years have you lived in this suburb?	___ years		
7. Do you live in an owner-occupied home, social housing or private rental property? (tick box or multiple choice)	owner-occupied home	social housing	private rental
8. Do you live with other(s) or alone?	With other(s)	Alone	
9. Do you receive care at home? (such as cleaning, personal care)	Yes	No	
10. Do you have a chronic illness or condition?	Yes	No	
11. Do you use a walker or wheelchair?	Yes	No	
12. What score would you give to your quality of life?	Score 1 - 10		

4. Results

4.1. Participant profiles

The vast majority of the 158 respondents lived in the Greater Adelaide Metropolitan area, with five living outside this region – further south in Goolwa, and further east in Murray Bridge (six respondents did not indicate where they lived), Fig. 2. There were more females who responded to the survey (64 % versus 36 %). All respondents lived in their own home, with almost 50 % having lived in the same house for >20 years. Out of 147 respondents, about 30 % (41 people) lived alone, with 32 of them (78 %) being females. About 94 % of all respondents indicated that they did not receive any care while 91 % did not use any mobility aid, indicating that the vast majority of these respondents were healthy, which coincided with their self-assessed quality of life score of 7 or higher (out of 10-points), which were 86 % of the respondents. This is despite almost 40 % indicating that they had a chronic illness or condition. The demographic profiles of the study population should be considered when analysing and interpreting the data later since this cohort is not broadly representative of older people in South Australia. For example, according to the Australian Bureau of Statistics, the latest National Health Survey conducted in 2022 showed that around 75 % (3 out of 4) of older people in Australia considered their health to be good or very good to excellent [29], indicating that the study population is skewed towards being healthier.

4.2. Respondent characteristics

Due to missing responses, only 147 participants were included in further analysis, with a mean age of 76.2 years (SD = 8.3). The majority of respondents were born in Australia (74.8 %), while 15.0 % were born in the United Kingdom and 9.5 % originated from other countries. Most participants had completed tertiary education, university, or vocational education and training (VET) (84.4 %), while 15.0 % had attained secondary or high school education, and only 0.7 % had completed primary school as their highest level of education. Many respondents (95.2 %) owned their homes, with a small proportion residing in social housing (2.0 %) or private rental accommodations (2.7 %). In terms of household composition, 30.6 % of respondents lived alone, while 69.4 % lived with others. Regarding health status, 8.2 % of respondents were receiving care, while the remaining 91.8 % were not. Chronic illness was reported by 39.5 % of participants. While a small proportion (8.8 %) used a mobility aid, a significant majority (91.2 %) did not require such assistance. Respondents self-reported a high quality of life score with a mean of 8.2 (SD = 1.2), indicating a generally high perception of well-being among the participants. See Table 3.

4.3. Confirmatory factor analysis

To evaluate the construct validity of the SustainABLE-16, Confirmatory Factor Analysis (CFA) was performed using the commonly used cut-off criteria to assess model fit. For the SustainABLE-16, the results indicated a normed χ^2 ratio of 4.767, which falls within the acceptable range. However, the CFI (0.729) and TLI (0.678) were well below the recommended threshold of 0.90, suggesting poor fit. Additionally, SRMR (0.1172) and RMSEA (0.161, 90 % CI [0.146–0.175]) exceeded acceptable levels, indicating substantial model misfit (Table 3).

Conversely, we continued to test the SustainABLE-8 which demonstrated a better overall fit. The normed Chi-square ratio (2.823) was well within the acceptable range, and the CFI (0.956) and TLI (0.927) met the recommended cut-off values. The SRMR (0.0614) also fell below the threshold of 0.08, indicating an adequate fit. However, the RMSEA (0.112, 90 % CI [0.075–0.150]) was above the acceptable range, suggesting moderate misfit in some aspects of the model. Given the relatively small sample size ($N = 147$), it is possible that the elevated RMSEA value was influenced by sample size limitations, as RMSEA tends to be

SustainABLE16 questionnaire

Please answer the question on a 5-point Likert scale.
1 = Totally disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Totally agree

Sustainability					
Pro-environmental behaviours					
1. I sometimes turn off lighting or equipment because of the costs.	1	2	3	4	5
2. I sometimes turn off lighting or equipment for the sake of the environment.	1	2	3	4	5
3. I consciously lower the heating in winter because of the costs.	1	2	3	4	5
4. I consciously lower the heating in winter for the sake of the environment.	1	2	3	4	5
5. When keeping my home cool during periods of heat, I am considerate of costs.	1	2	3	4	5
6. When keeping my home cool during periods of heat, I am considerate of the environment.	1	2	3	4	5
Financial position					
7. I can pay my energy bills.					
8. I have the financial means to implement energy-saving measures in my home.	1	2	3	4	5
9. I have sufficient financial means to lead an environmentally conscious life.	1	2	3	4	5
Beliefs					
10. I am concerned about climate change.					
11. I separate my household waste where I can (e.g. recycling).	1	2	3	4	5
12. I think it is important to use sustainable energy.	1	2	3	4	5
13. I have implemented measures to lead a more sustainable life.	1	2	3	4	5
14. I am willing to eat less or no meat to improve the environment.	1	2	3	4	5
15. I am willing to eat seasonal foods more frequently to improve the environment.	1	2	3	4	5
16. I believe that biodiversity affects my quality of life.	1	2	3	4	5

Fig. 1. SustainABLE-16 Questionnaire [17].

Table 2
Measurement model inter-factor correlations.

Latent factor	Item	Standardised loading (λ)	SE	CR (z)	R^2
Pro-environmental behaviours	2	0.83	.085	12.819	0.69
	4	0.81	.099	7.145	0.66
	6	0.89	.088	10.514	0.79
	Composite reliability (ρc)				0.88
	Average variance extracted (AVE)				0.71
Financial position	7	0.65	.059	27.570	0.42
	8	0.91	.101	9.922	0.83
	9	0.95	.094	11.069	0.90
	Composite reliability (ρc)				0.88
	Average variance extracted (AVE)				0.72
Beliefs	12	0.74	.075	20.711	0.55
	13	0.86	.077	16.343	0.74
	Composite reliability (ρc)				0.78
	Average variance extracted (AVE)				0.64
Total scale				ρc = 0.947	

biased upward in smaller samples [30]. Overall, the SustainABLE-8 exhibited a stronger fit to the data than the SustainABLE-16 (Table 4). The items of SustainABLE-8 are shown in Table 5.

4.4. Structural model of the sustainable-8

The structural model of SustainABLE-8, as illustrated in Fig. 3, demonstrates the relationships between three latent constructs: Pro-environmental behaviours, Financial position, and Beliefs. Each construct is represented by its respective observed variables (2, 4, 6 for Pro-environmental behaviours; 7, 8, 9 for Financial position; and 12, 13 for Beliefs), with standardised factor loadings provided for each item.

The model indicates strong factor loadings for most items, suggesting that the observed variables reliably represent their respective latent constructs. Notably, the factor loadings for the Financial position construct ranged from 0.65 to 0.95, demonstrating strong internal consistency. Similarly, the Beliefs construct exhibited high factor loadings (0.74 and 0.86) as well as the Pro-environmental behaviours construct with factor loadings ranging from 0.81 to 0.89.

Inter-factor correlations reveal the degree of association between the latent constructs. A higher correlation value indicates a stronger relationship between two constructs. The highest correlation was observed between Pro-environmental behaviours and Beliefs ($r = 0.76$), suggesting a strong association between these two domains. This was followed by the correlation between Financial position and Beliefs ($r = 0.41$), and the weakest correlation was found between Pro-

Fig. 2. Places of residences of respondents (Greater Adelaide Metropolitan area is indicated by the red line).

Table 3
Demographic characteristics of respondents on SustainABLE-16 items ($n = 147$).

	Variable	Category	N = 147	%
Personal	Age	Mean (SD)	76.2 (8.3)	
	Country of Birth	Australia	110	74.8
		United Kingdom	22	15.0
		Other	14	9.5
	Education Level	Primary School	1	0.7
		Secondary/High School	22	15.0
		Tertiary/ University/VET	124	84.4
Living arrangement	Living Arrangement	Owner Occupied	140	95.2
		Social Housing	3	2.0
		Private Rental	4	2.7
	Living Alone	Yes	45	30.6
		No	102	69.4
Health and Well-being	Receiving Care	Yes	12	8.2
		No	135	91.8
	Chronic Illness	Yes	58	39.5
		No	89	60.5
	Using a Mobility Aid	Yes	13	8.8
		No	134	91.2
	Quality of Life	Mean (SD)	8.2 (1.2)	

Note: data presented here for complete responses only.

environmental behaviours and Financial position ($r = 0.34$). These results indicate that while all constructs are interrelated, Pro-environmental behaviours and Beliefs exhibit the strongest connection, whereas the Financial position domain is somewhat more independent. Overall, the results suggest that SustainABLE-8 captures the theoretical constructs effectively.

In addition, the measurement-model analysis supported the intended structure: all items loaded strongly and significantly on their respective factors (CR = 7.145–27.570, $p < .001$); convergent validity was evidenced by Average Variance Extracted (AVE) values of 0.71 (Pro-environmental behaviours), 0.72 (Financial position) and 0.64 (Beliefs). The full item statistics (λ, SE, CR, R^2) and the Fornell–Larcker matrix have been provided in Table 2.

Table 4
Fit indices for sustainable-16 and sustainable-8 questionnaires.

	Normed χ^2	df	CFI	TLI	SRMR	RMSEA [90 % CI]
SustainABLE-16	4.767	101	0.729	0.678	0.1172	0.161 [0.146-0.175]
SustainABLE-8	2.823	17	0.956	0.927	0.0614	0.112 [0.075–0.150]

χ^2 = Normed Chi-square ratio (χ^2/df);df = Degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis; SRMR = Standardised Root Mean Square; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval.

4.5. Reliability of the sustainable-8 Australia

The composite reliability of the SustainABLE-8 total scale was excellent (0.947), indicating a high level of internal consistency. The subscales also demonstrated good reliability, with Pro-environmental behaviour at 0.882, Financial position at 0.879, and Beliefs at 0.777, see Table 6. Discriminant validity was satisfied because $\sqrt{}$AVE (0.84, 0.85, 0.80) exceeded the corresponding inter-factor correlations (r = 0.34–0.76), see Table 2. These values suggest that the SustainABLE-8 and its subscales reliably measure their intended constructs, with the Beliefs subscale showing the lowest, yet still acceptable, reliability.

4.6. South Australian results on sustainability

Fig. 4 presents the distribution of scores for Pro-environmental behaviours (PEB), Financial position (FP), Beliefs (B), and Total scores. The score ranges varied across constructs, with PEB and FP spanning from

Table 5
SustainABLE-8 questionnaire [20].

Item	Domain	Totally disagree	Disagree	Neutral	Agree	Totally agree
Pro-environmental behaviours						
2	I sometimes turn off lighting or equipment for the sake of the environment.					
4	I deliberately reduce the heating in winter for the sake of the environment.					
6	When keeping my home cool during the summer or heatwaves, I am conscious of the environment.					
Financial Position						
7	I can pay my energy bills.					
8	I have the financial means to implement energy-saving measures in my home.					
9	I have sufficient financial means to live an environmentally conscious life.					
Beliefs						
12	I think it is important to use sustainable energy.					
13	I have implemented measures myself to lead a more sustainable life.					

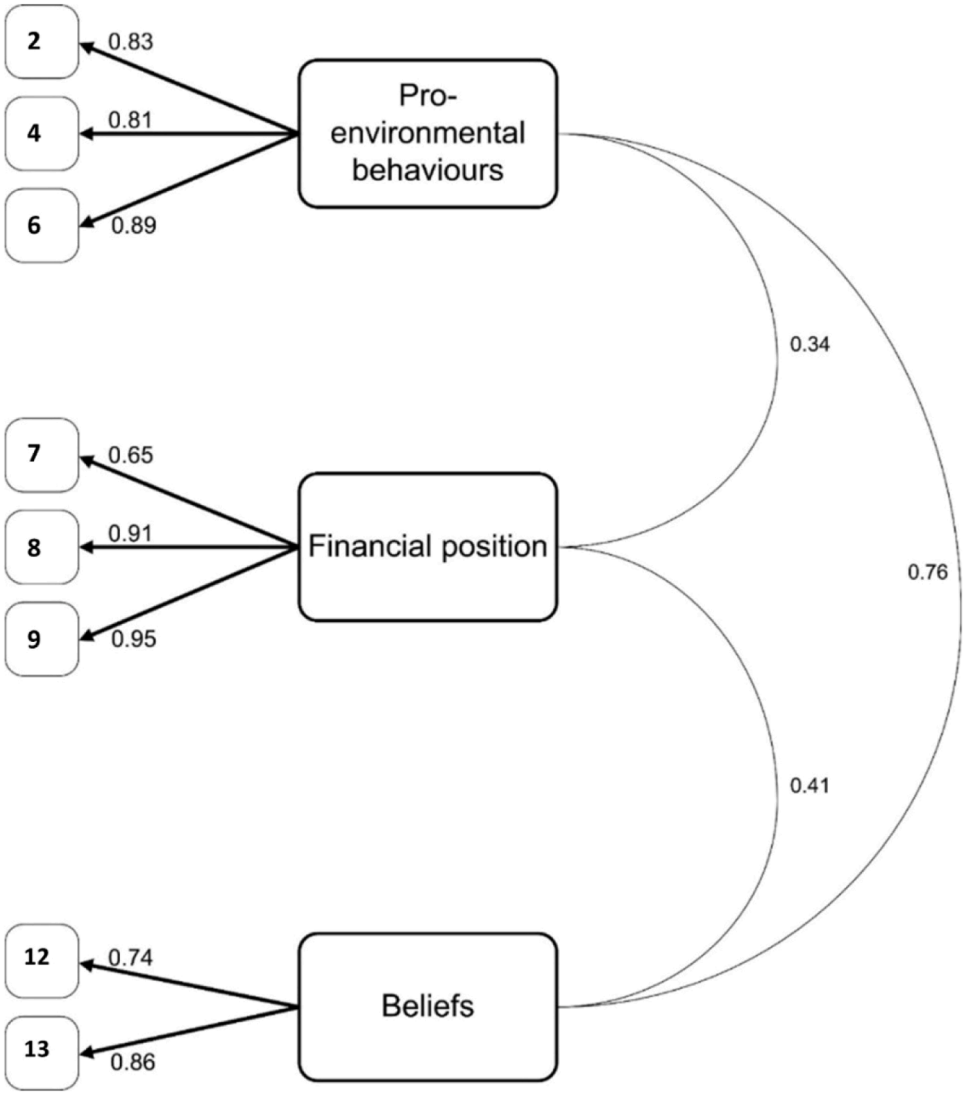

Fig. 3. PATH diagram regarding the factor structure of the Australian SustainABLE-8.

Table 6
Composite reliability of the SustainABLE-8 and sub-domains.

	SustainABLE-8 total	Pro-environmental behavior	Financial position	Beliefs
Composite reliability	0.947	0.882	0.879	0.777

−6 to +6, Beliefs ranging from −4 to +4, and Sustainability spanning the total range from −16 to +16.

The Pro-environmental behaviours (PEB) scores were skewed towards the upper end of the scale, with the highest frequency observed at a score of +6, followed by moderate peaks at scores around 3 and 0. Similarly, Financial position (FP) scores showed a strong clustering at +6, suggesting that most participants perceived their financial position positively. The Beliefs (B) scores were highly skewed, with a substantial proportion of participants scoring at the maximum value of +4,

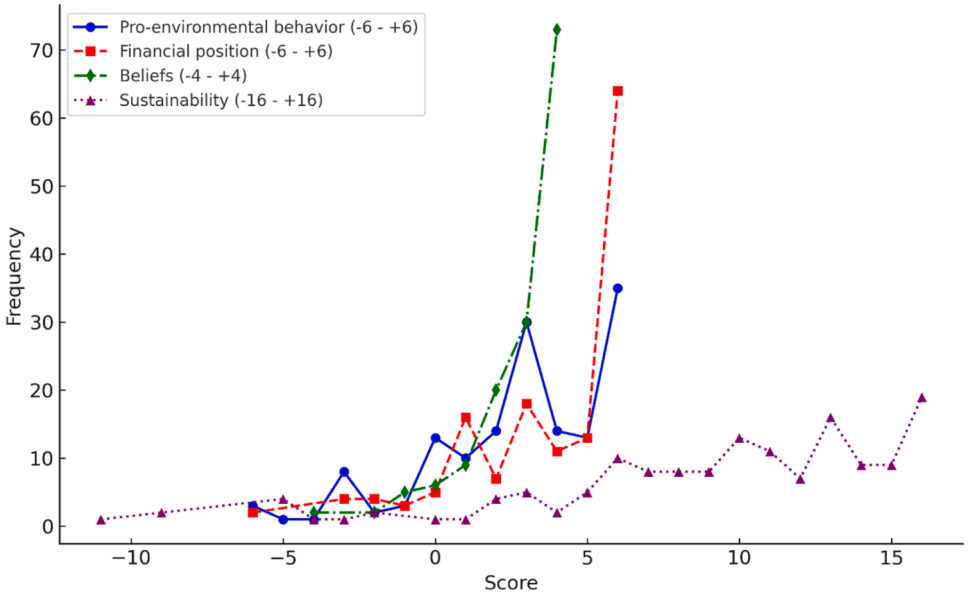

Fig. 4. Distribution of key variables.

indicating that strong beliefs in sustainability-related principles were prevalent. Consequently, the Sustainability total scores also demonstrated a clear tendency toward higher values, with the largest frequencies occurring at scores of +13, +15, and +16. This pattern suggests that the majority of participants scored toward the upper end of the sustainability spectrum, indicating a generally strong inclination toward sustainability-oriented behaviours and attitudes.

A total of 69 participants also provided comments on sustainability-related topics. Qualitative analysis of these comments revealed distinct themes in relation to participants' scores across the different domains. Participants with negative scores in Pro-environmental behaviours (6 individuals) often expressed skepticism about current sustainability initiatives. A recurring theme was the concern about the aggressive timelines of energy transitions, particularly in Australia, with several respondents advocating for nuclear power as a necessary alternative. For example, one participant noted,

> *"Australia is adopting very aggressive timelines, which will lead to challenges in grid stability, energy storage, and very high costs by refusing to consider nuclear."*

For those with negative scores in Financial position (4 individuals), affordability was a major concern. Respondents noted that sustainable choices were often financially inaccessible, limiting their ability to engage in environmentally-friendly behaviours. This highlights a potential economic barrier to sustainability engagement. One respondent remarked,

> *"Installing solar panels or switching to an electric car is simply not financially realistic for many people."*

Participants with negative scores in Beliefs (4 individuals) tended to reject enforced sustainability measures, and instead advocating for personal responsibility over government-led initiatives. Their comments emphasised a need for balanced policies rather than stringent sustainability regulations. One stated,

> *"Sustainability should be encouraged, not forced. People should have the right to make their own choices rather than being pressured by policy."*

The majority of comments came from participants with positive scores across all domains. These individuals frequently discussed practical sustainability solutions, expressed support for environmental initiatives, and provided personal examples of sustainable behaviours, such as installing solar panels or reducing waste. One respondent highlighted,

> *"We installed solar panels and reduced plastic use significantly. Small steps make a big difference."*

Another mentioned,

> *"Recycling initiatives should be expanded. I would love to see more community efforts to encourage sustainable habits."*

Two individuals expressed concerns about policy enforcement and economic feasibility, nonetheless, this qualitative analysis highlights that financial concerns and skepticism about policy approaches were key factors for those scoring negatively, while those with positive scores tended to reinforce and advocate for sustainability measures.

5. Discussion

Similar to the results in Poland, Romania, North Macedonia and Israel [19], this study found that the SustainABLE-16 model did not fit the South Australian context well, possibly because some questions were too culturally sensitive and too specific for the Dutch context. For example, people in the Netherlands eat less meat (per capita) than people in Australia [36], thus reducing meat consumption for the sake of the environment (item 14 of SustainABLE-16) was perceived as possible and relevant. On the other hand, the respondents in Australia might have perceived reducing meat consumption to be more difficult to do, hence they did not think this was a necessary nor realistic option in order to live sustainably. Another issue more pertinent to context of The Netherlands is the cost of heating and fuel costs in general, which were much higher than that in Australia. As a result, the respondents in The Netherlands considered anything to do with lowering the electricity or fuel costs (items 1, 3, 5 of SustainABLE-16) to be relevant and important, whereas the respondents in Australia did not consider these to be relevant. It is also possible that the Australian respondents did not consider these items to be important due to their financial position, which will be discussed below.

Nonetheless, the alternative and shortened version, SustainABLE-8, exhibited a strong fit to the data as shown in the acceptable normed Chi-square ratio, CFI and TLI of 2.812, 0.956 and 0.927, respectively, with acceptable values of 5 or lower, higher than 0.9, and higher than 0.9, respectively.

When the structural model of SustainABLE-8 in this study was further

analysed, the three latent constructs – Pro-environmental behaviours, Financial position and Beliefs all had strong factor loadings, indicating that the observed variables reliably represented their respective latent constructs. A further analysis showed that there was a strong association between Pro-environmental behaviours and Beliefs. Likewise, the latent construct of Financial Position was found to correlate with Beliefs, though the correlation was weaker. The weakest correlation was found between Pro-environmental behaviours and Financial Position.

Examining individual responses, the weak correlation between Pro-environmental behaviours and Financial Position seemed to be influenced by the fact that >60 % of the respondents stated that they were able to pay their energy bills and had the financial means to implement energy-saving measures in their home, indicating that they possibly came from mid to higher income levels. At the same time, they also stated that they would reduce their heating during winter for the sake of the environment and they were conscious about the environmental impact when they cooled their homes during summer or heatwaves. In other words, the heating and cooling behaviours of the majority of respondents were influenced more by their beliefs in sustainability rather than financial constraints. It is possible that if the study had captured a wider range of the socio-economic statuses among older people, including a larger proportion of people with lower socio-economic status, that different correlations between the three latent constructs would be found. Indeed, an earlier survey-based study of older people in South Australia [31] found that concerns related to the running costs of heating and cooling, which in turn influenced heating and cooling behaviours, came from people in the lowest income bracket of less than AU $30,000 per year. In the current study, all four respondents with negative scores in Financial Position mentioned that their financial situation put restricted their ability to live more sustainably; however, this was a minority. The majority indicated that they applied Pro-environmental behaviours, such as running the heating and cooling equipment efficiently, although they were able to afford heating and cooling bills, because they believed in sustainability.

6. Limitations

Even though the SustainABLE-8 has been shown to be a valid instrument to be implemented in South Australia, this validation exercise has limitations. First, the number of respondents was smaller ($n = 158$] than that in the validation studies in Poland ($n = 801$), Romania ($n = 424$), North Macedonia ($n = 515$) and Israel ($n = 223$) [18.19]. Nonetheless, this sample size is still sufficient for validation purposes, particularly since only confirmatory factor analysis was performed. A commonly cited rule of thumb for CFA is to have at least 5 to 10 participants per estimated parameter or item [35]. Given that the SustainABLE-8 consists of only 8 items, our sample size of 158 is well above the minimum requirement. Furthermore, an exploratory factor analysis was not necessary, as the factor structure of the SustainABLE-8 was already well-established through prior validation studies. Nevertheless, while the sample size supports construct validation, it is not large enough to allow for generalizable conclusions about the Greater Adelaide Metropolitan area population.

Second, based on the answers to questions indicating financial position, most respondents were from mid to higher income levels and the majority were university graduates. It was also possible to tell from suburb names that many respondents were from more affluent areas. Only two respondents lived in areas with low Index of Relative Socio-economic Disadvantage (IRSD) or low Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) [32] and thus we were unable to further analyse whether financial constraints correlated with sustainability perception or behaviours. In contrast, the study conducted in Poland and Macedonia, also using SustainABLE-8, was able to identify a cluster of around 20 % of the total respondents having limited financial resources and these constraints were shown to have affected their ability to engage in pro-environmental behaviours [19]. While the percentage of those with financial constraints was lower in Romania and Israel (around 13 % and 5 %, respectively), the validation studies conducted in those countries were still able to identify the relationship between financial position and pro-environmental behaviours [19].

Third, the cultural background of the respondents in the current study was homogenous compared to the broader Australian population with the latest data showing that 20 % of older Australians were born in non-English speaking countries [33]. In this study, 73 % of the respondents were born in Australia while the remaining, except four respondents, were born in western, English-speaking countries (USA, UK, Ireland and New Zealand). In other words, the study failed to capture respondents from culturally and linguistically diverse backgrounds, many of whom live in the low IRSD/IRSAD communities. Recruitments through the WeekendPlus magazine might have attracted only higher educated people from English-speaking backgrounds and with higher incomes.

7. Conclusion and future implications

The SustainABLE-16 instrument has been adapted and validated for a South Australian context. Although the number of respondents in this study ($n = 147$) was lower than in some international validation studies, the sample size was nevertheless sufficient for robust validation and testing. The findings indicate that while the full version of the instrument (i.e. SustainABLE-16) was less suited to this context, the shorter SustainABLE-8 proved to be a reliable and valid measure for use in South Australia. This suggests that the SustainABLE-8 can be confidently applied to assess sustainability-related constructs within this regional setting.

Using SustainABLE-8, the study found that among respondents, Pro-environmental behaviours were mainly determined by Beliefs in sustainability rather than influenced by Financial Position. It is likely, however, that this result was due to the fact that the majority of the respondents were those who had a positive financial position and had higher levels of education, which informed an understanding about the importance of sustainability that motivated them to have Pro-environmental behaviours.

The promising results from this study provide a strong foundation for the use of the SustainABLE-8 instrument in Australia. For example, by applying the SustainABLE-8 questionnaire to assess the views and behaviours of older people towards environmental sustainability at community, city, regional and even national levels, policy makers can prioritise certain policies and plans, based on the responses to the questionnaire. The results can even be further analysed to identify different clusters that may exist among older people in Australia based on the demographic and socio-economic backgrounds, living arrangement and health and wellbeing status. Having a clearer picture of the different clusters of older people in the community will further help policy makers as well as other relevant organisations to develop targeted policies and strategic plans and actions to ensure the health and wellbeing of older people regardless of their various backgrounds. Therefore, to further strengthen the applicability of this instrument, future validation with more diverse samples—including older people from lower socio-economic backgrounds and culturally and linguistically diverse communities—is recommended.

CRediT authorship contribution statement

Veronica Soebarto: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jeroen Dikken:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Helen Barrie:** Writing – review & editing,

Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Romy Wasserman:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Joost van Hoof:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, 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.

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Data availability

Data will be made available on request.

References

[1] R. Goodland, The concept of environmental sustainability, Annu Rev. Ecol. Syst. 26 (1995) 1–24. https://www.jstor.org/stable/2097196.
[2] M. Crane, S. Lloyd, A. Haines, D. Ding, E. Hutchinson, K. Belesova, Transforming cities for sustainability: a health perspective, Env. Int. 147 (2021) 106366, https://doi.org/10.1016/j.envint.2020.106366.
[3] J. van Hoof, V. Soebarto, L. Ayalon, H.R. Marston, K.K. Zander, J. Dikken, J. K. Kazak, Ten questions concerning older people and a sustainable built environment, Build Env. 274 (2025) 112742, https://doi.org/10.1016/j.buildenv.2025.112742.
[4] A. Kriebel-Gasparro, Climate Change: effects on the older adult, J. Nurse Pract. 18 (4) (2022) 372–376, https://doi.org/10.1016/j.nurpra.2022.01.007.
[5] R.C. Franklin, H.M. Mason, J.C. King, A.E. Peden, J. Nairn, L. Miller, K. Watt, G. FitzGerald, Heatwaves and mortality in Queensland 2010-2019: implications for a homogenous state-wide approach, Int. J. Biometeorol. 67 (2023) 503–515, https://doi.org/10.1007/s00484-023-02430-6.
[6] R. Patrick, R. Garad, T. Snell, J. Enticott, G. Meadows, Australians report climate change as a bigger concern than COVID-19, J. Clim. Change Health 3 (2021) 100032, https://doi.org/10.1016/j.joclim.2021.100032.
[7] COTA NSW, 50+. What Older People Think, Council on the Ageing NSW, Australia, 2021. https://www.cotansw.com.au/wp-content/uploads/2023/05/COTA-50-Report-2022-What-Older-People-Think.pdf.
[8] S. Bondio, M. Shahnazari, A. McHugh, The technology of the middle class: understanding the fulfilment of adoption intentions in Queensland's rapid uptake residential solar photovoltaics market, Renew. Sustain. Energy Rev. 93 (2018) 642–651, https://doi.org/10.1016/j.rser.2018.05.035.
[9] X. Hu, Environmental sustainability and the residential environment of the elderly: a literature review, Build Env. 206 (2021) 108337, https://doi.org/10.1016/j.buildenv.2021.108337.
[10] J. van Hoof, J.L.M. Hensen, Thermal comfort and older adults, Gerontechnology 4 (4) (2006) 223–228, https://doi.org/10.4017/gt.2006.04.04.006.00.
[11] J. van Hoof, Older people going green out of financial necessity: environmental sustainability and age-friendly cities, Indoor. Built. Environ. 33 (1) (2024) 3–7, https://doi.org/10.1177/1420326X231156672.
[12] A. Hansen, M. Nitschke, P. Bi, P. Pisaniello, et al., Heat-health behaviours of older people in two Australian states, Aust. J. Ageing 34 (1) (2014) 19–25, https://doi.org/10.1111/ajag.12134.
[13] R.J. Klein, P.L. Kinney, K.N. Metzger, Intra-urban vulnerability to heat-related mortality in New York City, Health Place 30 (2014) 45–60, https://doi.org/10.1016/j.healthplace.2014.07.014.
[14] COTA Australia, Climate Change, Council on the Ageing Australia, 2025. Available onlineAccessed 28 March 2025.
[15] World Health Organization, Making Older Persons Visible in the Sustainable Development Goals' Monitoring Framework and Indicators, World Health Organization, Geneva, Switzerland, 2024. ISBN 978-92-4-009024-8 (electronic version). Available online, https://iris.who.int/bitstream/handle/10665/376154/9789240090248-eng.pdf?sequence=1. Accessed 21 August 2025.
[16] Y. Wang, F. Hao, Y. Liu, Pro-environmental behavior in an aging world: evidence from 31 countries, Int. J. Env. Res. Public Health 18 (4) (2021) 1748, https://doi.org/10.3390/ijerph18041748.
[17] J. Dikken, J.K. Kazak, V. Soebarto, J. van Hoof, Views of older people on environmental sustainability: the development of the SustainABLE-16 questionnaire, Build Env. 242 (2023) 110514, https://doi.org/10.1016/j.buildenv.2023.110514.
[18] J. van Hoof, J. Dikken, Revealing sustainable mindsets among older adults concerning the built environment: the identification of six typologies through a comprehensive survey, Build Env. 256 (2024) 111496, https://doi.org/10.1016/j.buildenv.2024.111496.
[19] J. Dikken, J.K. Kazak, D. Pavlovski, L. Ivan, L. Ayalon, J.M. Perek-Białas, J. van Hoof, Four European typologies of older adults concerning environmental sustainability, Renew. Sustain. Energy Rev. 211 (2025) 115276, https://doi.org/10.1016/j.rser.2024.115276.
[20] J. Dikken, J.K. Kazak, L. Ivan, L. Ayalon, D. Pavlovski, J.M. Perek-Białas, J. van Hoof, Perspectives of older people on environmental sustainability: a cross-cultural validation study between five countries, J. Clean. Prod. 447 (2024) 141317, https://doi.org/10.1016/j.jclepro.2024.141317.
[21] R. Wasserman, H. Barrie, J. Dikken, J. van Hoof, V. Soebarto, Validating the age-friendly cities and communities questionnaire in australia: revealing five distinct groups of older people in greater adelaide, Habitat. Int. 156 (2025) 103278, https://doi.org/10.1016/j.habitatint.2024.103278.
[22] J. van Hoof, H.R. Marston, J.K. Kazak, T. Buffel, Ten questions concerning age-friendly cities & communities and the built environment, Build Env. 199 (2021) 107922, https://doi.org/10.1016/j.buildenv.2021.107922.
[23] J. van Hoof, V. Soebarto, L. Ayalon, H.R. Marston, K.K. Zander, J. Dikken, J. K. Kazak, Ten questions concerning older people and a sustainable built environment, Build Env. 274 (2025) 112742, https://doi.org/10.1016/j.buildenv.2025.112742.
[24] L.T. Hu, P.M. Bentler, Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives, Struct. Equ. Model. 6 (1999) 1–55, https://doi.org/10.1080/10705519909540118.
[25] M.W. Browne, R. Cudeck, Alternative ways of assessing model fit, in: K.A. Bollen, J. S. Long (Eds.), Testing Structural Equation Models, Sage, Newbury Park, CA, 1993, pp. 136–162.
[26] P.M. Bentler, Comparative fit indexes in structural models, Psychol. Bull. 107 (2) (1990) 238–246, https://doi.org/10.1037/0033-2909.107.2.238.
[27] T. Raykov, Estimation of composite reliability for congeneric measures, Appl. Psychol. Meas. 21 (2) (1997) 173–184, https://doi.org/10.1177/01466216970212006.
[28] IBM Corp, IBM Amos version 28.0, SPSS, Chicago, 2021.
[29] Australian Bureau of Statistics, National Health Survey, ABS, 2022. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/national-health-survey/latest-release.
[30] F. Chen, P.J. Curran, K.A. Bollen, J. Kirby, P. Paxton, An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in Structural Equation Models, Sociol. Methodol. Res. 36 (4) (2008) 462–494, https://doi.org/10.1177/0049124108314720.
[31] Soebarto, V., Bennetts, H., Hansen, A., Zuo, J., Williamson, T., Pisaniello, D., Visvanathan, R. (2019). Living environment, heating-cooling behaviours and well-being: survey of older South Australians. Build. Environ., 157, 215–226. https://doi.org/10.1016/j.buildenv.2019.03.023.
[32] Australian Bureau of Statistics, Census of population and housing: Socio-Economic Indexes for Areas (SEIFA), in: Australia, 2016. https://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001.
[33] Australian Institute of Health and Welfare, Older Australians, Available online at, https://www.aihw.gov.au/reports/older-people/older-australians/contents/population-groups-of-interest/culturally-linguistically-diverse-people, 2024. Accessed 11 April 2025.
[34] V. Shevelkova, C. Mattocks, L. Lafortune, Efforts to address the sustainable development goals in older populations: a scoping review, BMC. Public Health 23 (2023) 456, https://doi.org/10.1186/s12889-023-15308-4.
[35] T.A. Brown, Confirmatory Factor Analysis For Applied Research, Guilford Press, New York, 2015.
[36] World Population Review, Meat consumption by country 2025, Available online at: https://worldpopulationreview.com/country-rankings/meat-consumption-by-country#title, 2025. Accessed 16 April 2025.