

# The global validation and results of an assessment tool for urban age-friendliness: A great leap forward towards an age-friendly world

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## Abstract

Age-friendly cities around the world aim to enhance the quality of life of older people. A network of like-minded cities and communities promotes the exchange of best practices, but faces challenges due to varying socio-economic and cultural contexts, which affects comparability and usability of shared information and limits mutual learning. The *Age-Friendly Cities and Communities Questionnaire* (AFCCQ) serves as a tool for assessment of cities' age-friendliness. This study validates the AFCCQ's cross-cultural applicability in ten countries (Italy, Poland, North Macedonia, Romania, the Netherlands, Australia, Turkey, Russia, Japan, and Israel) through data from 4648 participants, testing measurement invariance with structural equation modelling. Finally, descriptive statistics provided a baseline comparison between countries. Results confirm that the AFCCQ enables a uniform assessment across countries, facilitating meaningful international comparisons. Findings aid global entities like the World Health Organization in fostering age-friendly environments and assist policymakers in developing effective age-friendly policies.

## Introduction

For nearly two decades, the World Health Organization (WHO) has been actively engaged in assisting cities and communities to become age-friendly (World Health Organization, 2007a). To date, 1739 cities and communities across 57 countries around the world are dedicated to enhancing the well-being of their older citizens, having united under the *WHO Global Network for Age-Friendly Cities and Communities* (GNAFCC). This network serves as a platform for the exchange of experiences and learning among its members of varying sizes (World Health Organization, 2026a). For this purpose, the GNAFCC offers access to a global database of age-friendly practices (World Health Organization, 2018). A significant challenge lies in the comparability and usability of the products placed on the platform due to the diverse socio-economic and cultural contexts in which individual efforts take place, which complicates mutual learning between members.

In order to assess the age-friendliness of urban environments, including the establishment of a baseline measure, a wide range of qualitative methods have been employed by scholars (van Hoof et al., 2021). In addition, scholars with

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a quantitative focus have attempted to develop indicator frameworks and survey instruments to measure the age-friendliness of cities and neighbourhoods, with many of these efforts rooted in the *Checklist of Essential Features of Age-Friendly Cities* as a reference (World Health Organization, 2007b). Some of these studies failed to reproduce the original eight age-friendly topics (also referred to as domains) by the WHO (van Hoof and Marston, 2025), came up with different factors, or lacked full transparency in all the necessary steps of instrument development (Menec and Nowicki, 2024; Kim et al., 2022; Orpana et al., 2016; Safa et al., 2024; Gibney and Ward, 2018; Garner and Holland, 2020; Wong et al., 2015; Yu et al., 2019). This is also a weakness in a wider context, as a recent commentary by Thiagarajan et al. (2022) stated that there are no reliable tools or survey protocols to measure healthy ageing. Yet, Plouffe et al. (2016) posited that an age-friendly community is about having a proper match between older people and the environment they live in, and not about conformity with a standard test and a determined series of features per se.

A more recent instrument, with promising validity and reliability results, is the *Age-Friendly Cities and Communities' Questionnaire* (AFCCQ), which serves as a quick-scan (Dikken et al., 2020). This 23-item instrument offers an all-encompassing systematic quantitative approach for evaluating and assessing age-friendly cities in a numerical format. The introduction of the AFCCQ allows for the monitoring of progress (or decline) and offers feedback on the potential value and impact of social programmes and policies (van Hoof et al., 2022; van Hoof et al., 2024). The AFCCQ is the first international quantifiable tool to measure age-friendliness, and it could set the foundations for additional sites (such as low- and middle-income countries) to conduct their own analysis by identifying domains that may need addressing at a municipality level. Further, this tool affords organisations that have a global presence, such as the United Nations and the World Health Organization, and purport directives and initiatives in this field, the opportunity to demonstrate the importance of such a tool, setting a precedent for quantifying age-friendly cities and communities.

The available evidence at this moment suggests that the AFCCQ shows acceptable validity and reliability across multiple countries (Özer et al., 2023; Ivan et al., 2024; Yamada et al., 2023; Perek-Białas et al., 2024; Pavlovski et al., 2024; Ayalon et al., 2024; Wasserman et al., 2025; Ziganshina et al., 2025; Bertani et al., 2025; Barata et al., 2026; Piercy et al., 2025; Grenz et al., 2025; AboJabel et al., 2025), supporting its use in international research settings. However, before countries can strengthen and intensify their mutual learning, one of the goals of the GNAFCC, it is important that the AFCCQ proves to be a valid tool for making meaningful comparisons between countries and/or cities. Only when this is assured, true international cooperation should be implemented, based on a valid foundation for identifying similarities, differences, and trends between countries.

The present study combines data collected from ten countries to demonstrate the cross-cultural psychometric properties of the AFCCQ. The work presented here sets out a best practice for academic and applied research, enabling evidence-based findings to be directly implemented by municipalities and local authorities to improve their respective communities, thus in turn, improving the lives of their residents and tourists alike. Scholars from the fields of gerontology, urban planning, geography, engineering, and social science can contribute to and drive innovative discourse by employing the AFCCQ in their respective investigations, leading to further novel insights and curated datasets for additional comparisons (van Hoof et al., 2021).

In the domain of cross-cultural research, the principle of measurement invariance (MI) is a crucial concept often overlooked or assumed by researchers (Jeong and Lee, 2019). MI is about demonstrating whether various groups in society are able to provide similar responses to a given instrument, or scale and its constituent items or questions. Scholars and practitioners are only able to compare the average scores provided by groups of respondents when using a given instrument, once MI has been demonstrated at a certain level. This is particularly true when working with groups of respondents who live in different countries or do not share a similar cultural background. After demonstrating MI, meaningful interpretations of the obtained results can be made.

When research participants who do not share the same mother tongue do not interpret scale items consistently, it may suggest a disparity in the fundamental structure of the instrument. Consequently, such an instrument cannot be considered suitable for making comparisons among these diverse countries, thereby hindering the formation of political decisions at a global level. As such, this study had two main objectives: (1) to examine the cross-cultural measurement invariance of the AFCCQ across ten countries to assess whether participants interpreted the items consistently; and (2) to compare AFCCQ domains and total scores between countries, providing initial evidence on

**Table 1** Demographic characteristics for all ten countries.

|                                                                 | Total<br>(n = 4648) | IT (n = 1213) | PL (n = 801) | MK<br>(n = 502) | RO<br>(n = 424) | NL<br>(n = 352) | AU<br>(n = 334) | TR (n = 306) | RU<br>(n = 265) | JP (n = 240) | IL (n = 222) |
|-----------------------------------------------------------------|---------------------|---------------|--------------|-----------------|-----------------|-----------------|-----------------|--------------|-----------------|--------------|--------------|
| <b>Sex, n (%)</b>                                               |                     |               |              |                 |                 |                 |                 |              |                 |              |              |
| Male                                                            | 1932 (41.5)         | 489 (40.3)    | 319 (39.8)   | 219 (43.6)      | 166 (39.2)      | 159 (45.2)      | 122 (36.5)      | 149 (48.7)   | 32 (12.1)       | 199 (82.9)   | 78 (35.1)    |
| Female                                                          | 2716 (58.3)         | 724 (59.7)    | 482 (60.2)   | 283 (56.4)      | 258 (60.8)      | 184 (52.3)      | 210 (62.9)      | 157 (51.3)   | 233 (87.9)      | 41 (17.1)    | 144 (64.9)   |
| <i>Missing values</i>                                           | 11 (0.2)            | -             | -            | -               | -               | 9 (2.6)         | 2 (0.6)         | -            | -               | -            | -            |
| <b>Age group, n (%)</b>                                         |                     |               |              |                 |                 |                 |                 |              |                 |              |              |
| <50 years old                                                   | 253 (5.4)           | -             | -            | -               | -               | -               | -               | -            | 179 (67.5)      | 72 (30.0)    | -            |
| 50–64 years old                                                 | 178 (3.8)           | -             | -            | 18 (3.6)        | -               | -               | 9 (2.7)         | 3 (1.0)      | 59 (22.3)       | 91 (37.9)    | -            |
| 65–74 years old                                                 | 2383 (51.1)         | 543 (44.8)    | 449 (56.1)   | 340 (67.7)      | 244 (57.5)      | 196 (55.7)      | 200 (59.9)      | 154 (50.3)   | 21 (7.9)        | 62 (25.8)    | 174 (78.4)   |
| 75–84 years old                                                 | 1358 (29.1)         | 489 (40.3)    | 236 (29.5)   | 132 (26.3)      | 131 (30.9)      | 106 (30.1)      | 107 (32.0)      | 95 (31.0)    | 5 (1.9)         | 12 (5.0)     | 45 (20.3)    |
| 85+ years old                                                   | 473 (10.2)          | 181 (14.9)    | 116 (14.5)   | 12 (2.4)        | 49 (11.6)       | 36 (10.2)       | 18 (5.4)        | 54 (17.6)    | 1 (0.4)         | 3 (1.3)      | 3 (1.4)      |
| <i>Missing values</i>                                           | 14 (0.3)            | -             | -            | -               | -               | 14 (4.0)        | 2 (0.6)         | -            | -               | -            | -            |
| <b>Country of birth, n (%)</b>                                  |                     |               |              |                 |                 |                 |                 |              |                 |              |              |
| Country of birth, n (%)                                         | 4393 (94.3)         | 1195 (98.5)   | 787 (98.3)   | 502 (100)       | 424 (100)       | 292 (83.0)      | 218 (65.3)      | 306 (100)    | 256 (69.6)      | 239 (99.6)   | 174 (78.4)   |
| <i>Missing values</i>                                           | 8 (0.2)             | -             | -            | -               | -               | 7 (2.0)         | 1 (0.3)         | -            | -               | -            | -            |
| <b>Educational level, n (%)</b>                                 |                     |               |              |                 |                 |                 |                 |              |                 |              |              |
| Low                                                             | 1083 (23.2)         | 421 (34.7)    | 61 (7.6)     | 178 (35.5)      | 28 (6.6)        | 153 (43.5)      | 8 (2.4)         | 188 (61.4)   | -               | 21 (8.8)     | 25 (11.3)    |
| Medium                                                          | 1834 (39.4)         | 473 (39.0)    | 414 (51.7)   | 221 (44.0)      | 239 (56.4)      | 40 (11.4)       | 112 (33.5)      | 46 (15.0)    | 183 (69.1)      | 23 (9.6)     | 83 (37.4)    |
| High                                                            | 1734 (37.2)         | 319 (26.3)    | 323 (40.3)   | 103 (20.5)      | 154 (36.3)      | 157 (44.6)      | 214 (64.1)      | 72 (23.5)    | 82 (30.9)       | 196 (81.7)   | 114 (51.4)   |
| <i>Missing values</i>                                           | 8 (0.2)             | -             | 3 (0.4)      | -               | 3 (0.7)         | 2 (0.6)         | -               | -            | -               | -            | -            |
| <b>Years living in the city/area, mean (SD)</b>                 | 52.0 (23.1)         | 64.6 (16.8)   | 62.0 (13.2)  | 59.7 (15.9)     | 51.7 (19.8)     | 50.5 (24.7)     | 43.8 (23.1)     | 25.6 (18.1)  | 28.8 (20.1)     | 22.9 (17.6)  | 40.5 (22.9)  |
| <i>Missing values, n (%)</i>                                    | 11 (0.2)            | 1 (0.1)       | -            | 1 (0.1)         | -               | 2 (0.6)         | -               | 1 (0.3)      | 6 (2.3)         | -            | -            |
| <b>Type of dwelling, n (%)</b>                                  |                     |               |              |                 |                 |                 |                 |              |                 |              |              |
| Owner                                                           | 3791 (81.4)         | 1088 (89.7)   | 684 (85.4)   | 486 (96.8)      | 350 (82.5)      | 194 (55.1)      | 277 (82.9)      | 170 (55.6)   | 221 (83.4)      | 137 (57.1)   | 184 (82.9)   |
| Renting                                                         | 696 (14.9)          | 125 (10.3)    | 75 (9.4)     | 16 (3.2)        | 74 (17.5)       | 157 (44.6)      | 55 (16.5)       | 39 (12.7)    | 32 (12.1)       | 92 (38.3)    | 38 (17.1)    |
| Other                                                           | 171 (3.7)           | -             | 42 (5.2)     | -               | -               | -               | 2 (0.6)         | 97 (31.7)    | 12 (4.5)        | 11 (4.6)     | -            |
| <i>Missing values</i>                                           | 1 (0.0)             | -             | -            | -               | -               | 1 (0.3)         | -               | -            | -               | -            | -            |
| <b>People living together with a spouse or partner, n (%)</b>   | 3364 (72.2)         | 842 (69.4)    | 569 (71.0)   | 417 (83.1)      | 306 (72.2)      | 152 (43.2)      | 201 (60.2)      | 273 (89.2)   | 232 (87.5)      | 207 (86.3)   | 165 (74.3)   |
| <i>Missing values</i>                                           | 19 (0.4)            | -             | 18 (2.2)     | -               | -               | 1 (0.3)         | -               | -            | -               | -            | -            |
| <b>People receiving care, n (%)</b>                             | 1056 (22.7)         | 447 (36.9)    | 150 (26.7)   | 66 (13.1)       | 129 (30.4)      | 93 (26.4)       | -               | 70 (22.9)    | 20 (7.5)        | 18 (7.5)     | 63 (28.4)    |
| <i>Missing values</i>                                           | 343 (7.4)           | -             | 8 (1.0)      | 1 (0.2)         | -               | 1 (0.3)         | 334 (100)       | -            | -               | -            | -            |
| <b>People living with one or more chronic conditions, n (%)</b> | 2044 (43.9)         | 509 (42.0)    | 483 (60.3)   | 227 (45.2)      | 164 (38.7)      | 133 (37.8)      | 255 (76.3)      | -            | 118 (44.5)      | 83 (34.6)    | 72 (32.4)    |
| <i>Missing values</i>                                           | 331 (7.1)           | -             | 13 (1.6)     | -               | -               | 3 (0.9)         | -               | 306 (100)    | 9 (3.4)         | -            | -            |
| <b>People using a wheeled walker or a wheelchair, n (%)</b>     | 711 (15.3)          | 85 (7.0)      | 175 (21.8)   | 74 (14.7)       | 181 (42.7)      | 68 (19.3)       | 64 (19.2)       | 44 (14.4)    | 0 (0.0)         | 6 (2.5)      | 14 (6.3)     |

**Table 1** continued

|                                                  | Total<br>( <i>n</i> = 4648) | IT ( <i>n</i> = 1213) | PL ( <i>n</i> = 801) | MK<br>( <i>n</i> = 502) | RO<br>( <i>n</i> = 424) | NL<br>( <i>n</i> = 352) | AU<br>( <i>n</i> = 334) | TR ( <i>n</i> = 306) | RU<br>( <i>n</i> = 265) | JP ( <i>n</i> = 240) | IL ( <i>n</i> = 222) |
|--------------------------------------------------|-----------------------------|-----------------------|----------------------|-------------------------|-------------------------|-------------------------|-------------------------|----------------------|-------------------------|----------------------|----------------------|
| <i>Missing values</i>                            | 8 (0.2)                     | -                     | 3 (0.4)              | -                       | -                       | 5 (1.4)                 | -                       | -                    | -                       | -                    | -                    |
| <b>Self-rated quality of life, mean<br/>(SD)</b> | 7.1 (2.1)                   | 7.4 (2.0)             | 6.7 (1.9)            | 5.8 (1.9)               | 6.9 (3.0)               | 7.8 (1.1)               | -                       | -                    | 7.9 (1.7)               | -                    | 8.0 (1.1)            |
| <i>Missing values, n (%)</i>                     | 900 (19.3)                  | -                     | 12 (1.5)             | 3 (0.6)                 | -                       | 4 (1.1)                 | 334 (100)               | 306 (100)            | 1 (0.4)                 | 240 (100)            | -                    |

similarities and differences in perceived age-friendliness of cities and an initial international reference point for cross-country comparisons.

## Methods

### Preparation of data collection

Before data collection could begin, a rigorous process of translation, adaptation and qualitative validation of the AFCCQ questionnaire was necessary for each partner country and language following the COSMIN protocol. This process included an independent forward-backward translation process, review by experts (content validation), review and pretesting by target population (face validation), and psychometric testing. All steps were described and shared in a study protocol, ensuring that the recruitment of participants followed the same standardised procedures throughout the study (COSMIN, 2026; Mokkink et al., 2010).

### The instrument

The AFCCQ is a self-report questionnaire (Dikken et al., 2020), comprising 23 items covering nine domains of age-friendliness (World Health Organization, 2007a; World Health Organization, 2015), as well as one's financial situation, which was recognised as a core indicator of age-friendly cities (van Hoof and Marston, 2025; van Hoof et al., 2026). Participants were asked to express their opinions using a 5-point Likert scale, with scores ranging from  $-2$  to  $+2$  (or: totally disagree to totally agree). Negative scores indicate disagreement with an item and/or domain, while positive scores indicate agreement. Given that the perspectives of older individuals were sought, negative scores can be interpreted as dissatisfaction, while positive scores indicate satisfaction.

To facilitate comparability across domains with different numbers of items, domain sum scores were normalised to a common scale ranging from  $-10$  to  $+10$ . Specifically, for each domain with  $k$  items, the domain sum score (range  $-2k$  to  $+2k$ ) was multiplied by  $5/k$ . For example, the Housing domain (2 items; range  $-4$  to  $+4$ ) was multiplied by 2.5 to obtain a normalised range of  $-10$  to  $+10$ .

### Population and data collection cross-cultural validation

Data collection of the original datasets took place between September 2022 and December 2023. Country- and city-specific details on sampling and recruitment (including eligibility criteria, sampling frames, ethics, response rates, survey modes, and representativeness) are provided in the corresponding national papers (van Hoof et al., 2022; van Hoof et al., 2024; Özer et al., 2023; Ivan et al., 2024; Yamada et al., 2023; Perek-Białas et al., 2024; Pavlovski et al., 2024; Ayalon et al., 2024; Wasserman et al., 2025; Ziganshina et al., 2025; Bertani et al., 2025). In total, 4648 participants residing in ten countries participated: the Netherlands, 1 city ( $n = 352$ ), Italy, 3 cities ( $n = 1213$ ), Poland, 2 cities ( $n = 801$ ), North Macedonia, 1 city ( $n = 502$ ), Romania, 1 city ( $n = 424$ ), Australia, 1 city ( $n = 334$ ), Turkey, 1 city ( $n = 306$ ), Russia, 1 city ( $n = 265$ ), Japan, 1 city ( $n = 240$ ), and Israel, 4 cities ( $n = 222$ ) (Table 1). To ensure that no significant demographic overrepresentation or underrepresentation influenced the results, MI was tested between each individual location (city) and, for Japan and Russia, between age groups  $<65$  and  $65+$  within countries before conducting cross-country comparisons at the national level.

The project was based on a secondary data analysis of existing datasets, which all received approval from institutional review boards. These individual studies were conducted in accordance with the principles of the Helsinki Declaration of Human Rights. Participants were recruited by post, online or via telephone, and consented to their participation in the study. Prior to filling out the AFCCQ and several demographic characteristics, respondents were informed about the study, the conditions of participation and the projected duration of 20 minutes.

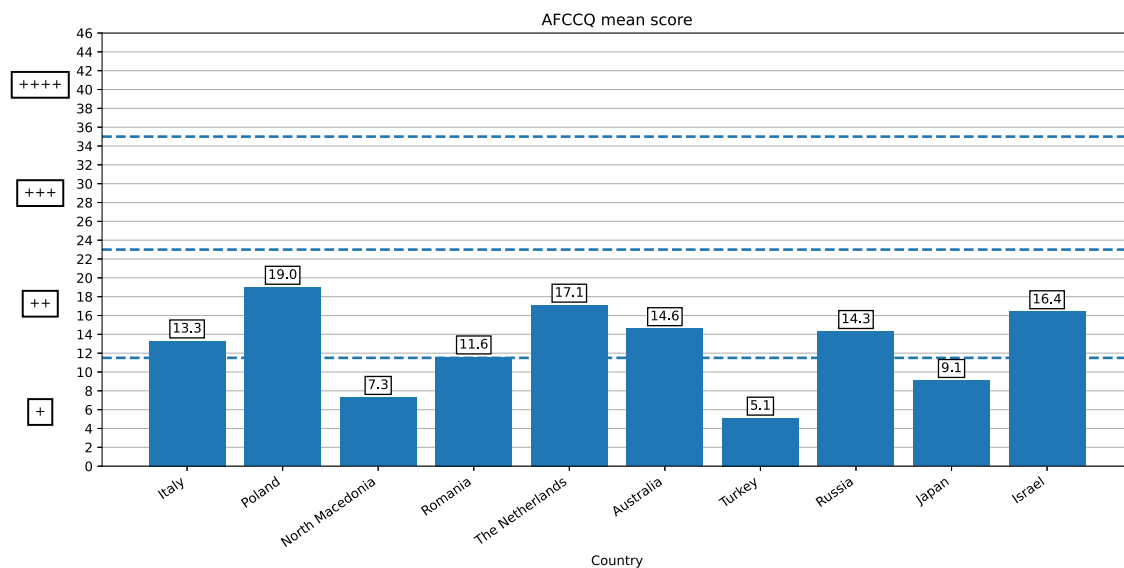
## Statistical analysis: Measurement invariance

MI was assessed using a multi-step approach across different countries. Initially, a single measurement model was constructed, encompassing all countries under investigation. Following this initial assessment, subsequent analyses were conducted on a country-by-country basis to scrutinise MI between individual countries. These analyses involved fitting separate models for two countries at a time and examining the equivalence of measurement parameters. Through this country-by-country assessment, cultural, linguistic, and/or socio-economic factors that could potentially influence MI can be detected. The findings from both the comprehensive single model and the detailed country-specific analyses are both important to provide a nuanced understanding of measurement equivalence across countries.

This integrated approach, doing analysis with different levels of aggregation, facilitated the identification of both overarching trends and country-specific nuances, enhancing the validity and reliability of the MI assessment.

To enable valid cross-country comparisons, the AFCCQ must measure identical constructs with consistent structure across different countries, demonstrating MI. MI indicates that participants interpret both individual items and underlying latent factors similarly across all groups. The step-by-step guideline for testing MI, outlined by van de Schoot et al. (2012), was followed for this study. Three levels of MI are described in the scholarly literature, namely configural, metric, and scalar invariance. To discover which level holds for the AFCCQ, several increasingly constrained models are tested and compared (van de Schoot et al., 2012; Byrne et al., 1989; Vandenberg and Lance, 2000). Only when scalar invariance is reached, the most stringent level, can meaningful comparison of means across groups be made. Researchers may instead turn to partial equivalence as an agreement, which requires at least two items per construct to be equivalent in order to allow for a valid comparison (Steenkamp and Baumgartner, 1998). Before testing invariance, the data were screened for missingness. Cases with missing values on AFCCQ items were excluded using listwise deletion (complete-case analysis); the measurement invariance analyses and subsequent descriptive and Kruskal–Wallis  $H$  tests were conducted on this complete-case dataset. Outlier removal procedures were not applied, as extreme AFCCQ scores were considered plausible expressions of respondents' perceived age-friendliness (i.e., reflecting meaningful marginal experiences rather than data errors). However, data were inspected for implausible or inconsistent values indicative of entry or coding errors.

Configural invariance of the AFCCQ was tested by conducting a confirmatory factor analysis (CFA) to assess how the construct of age-friendliness was theoretically operationalised by its developers (Dikken et al., 2020). This CFA model was fitted for each country individually in order to test whether the same CFA was valid for each sample. Model fit was evaluated using the normed  $\chi^2$  (Schumacker and Lomax, 2004; Shadfar and Malekmohammadi, 2013), the Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) (Hu and Bentler, 1995), the root-mean squared residual (SRMR) (Hu and Bentler, 1999), and the root-mean square error of approximation (RMSEA) (Hu and Bentler, 1999; MacCallum et al., 1996). Thereafter, the internal consistency of the final model was assessed using the Composite Reliability (Hair et al., 2014). When configural invariance was achieved for all countries, metric invariance was tested by running a series of models using the same fit measures assessing the fit of the increasingly constrained models. Also, these models with additional constraints (for instance, equality of factor loadings, intercepts, and so on) were assessed for deterioration of model fit ( $\Delta\text{CFI} \geq -0.01$ ;  $\Delta\text{SRMR} \leq 0.03$ ;  $\Delta\text{RMSEA} \leq 0.015$ ). Invariance was evaluated primarily using changes in fit indices; however, given the many-group setting, commonly used cut-offs and criteria proposed for large-scale cross-national comparisons were considered too. In the first model, only the factor loadings were equal across groups (i.e., constrained), but the intercepts were allowed to vary between the included groups. Then, a new model ran where only the intercepts were equal across groups (i.e., constrained), but the factor loadings were allowed to vary from one group to another. This step was taken to test if the meaning of the levels of the underlying items (intercepts) were equal between the included groups. Finally, scalar invariance was tested by running a model in which both the loadings and intercepts were constrained to be equal. All of the statistical analyses described above were conducted in SPSS AMOS version 26 (Arbuckle, 2019).



**Fig. 1** AFCCQ mean scores for all ten countries (raw scores: range  $-46$  to  $+46$ ).

## Statistical analysis comparison on AFCCQ results

The AFCCQ results were analysed using descriptive statistics in order to summarise the data's central tendency and variability. Differences among countries were then assessed using the Kruskal-Wallis  $H$ -test, a test suited for non-normally distributed or ordinal data (Kruskal and Wallis, 1952). Subsequent pairwise comparisons were conducted using Dunn's test. This test was used to point out divergences between pairs of countries (Dunn, 1964). Exact two-tailed  $p$ -values from Dunn's test are shown and statistical significance was evaluated at  $p < 0.05$ . All of the statistical analyses described in this paragraph were done using SPSS Version 29 (IBM Corp, 2021).

## Results

In total, 4648 participants with complete data on the AFCCQ items were included: Italy ( $n = 1213$ ), Poland ( $n = 801$ ), North Macedonia ( $n = 502$ ), Romania ( $n = 424$ ), the Netherlands ( $n = 352$ ), Australia ( $n = 334$ ), Turkey ( $n = 306$ ), Russia ( $n = 265$ ), Japan ( $n = 240$ ), and Israel ( $n = 222$ ) (Table 1; Fig. 1). Missing values were present in some demographic variables.

## Measurement invariance of the AFCCQ

Ensuring a valid comparison across a diverse set of countries requires that the AFCCQ assesses truly identical constructs with consistent structures. For all countries, the AFCCQ proved consistent and mostly met the fit indices criteria (Table 2). For some countries, one fit measure did not meet the criteria (i.e., TLI for North Macedonia and Japan; RMSEA for Romania and Turkey), which can be caused by variations in the cultural context, measurement error, or the specific characteristics of the samples in those countries. Because the other fit indices in these respective countries met their respective thresholds, the overall configural model evaluation for all countries was deemed acceptable.

Metric invariance was largely supported (Table 3). While the decrease in CFI from the configural to the metric model ( $\Delta\text{CFI} = -0.015$ ) slightly exceeded the commonly used  $-0.01$  criterion, changes in RMSEA ( $\Delta\text{RMSEA} = 0.005$ ) and SRMR ( $\Delta\text{SRMR} = 0.0175$ ) remained within recommended thresholds. Given the multi-country (many-group) design, we also considered cut-offs proposed for large-scale international comparisons (for

**Table 2** Fit of data with the original model as described by Dikken et al. (2020).

|                                      | Normed $\chi^2$ [df] | CFI   | TLI   | SRMR   | RMSEA [90% CI]      |
|--------------------------------------|----------------------|-------|-------|--------|---------------------|
| <b>Italy</b> ( $n = 1213$ )          | 2.329 [194]          | 0.968 | 0.959 | 0.0283 | 0.033 [0.029–0.037] |
| <b>Poland</b> ( $n = 801$ )          | 2.746 [194]          | 0.951 | 0.936 | 0.0441 | 0.047 [0.042–0.051] |
| <b>North Macedonia</b> ( $n = 502$ ) | 3.473 [194]          | 0.909 | 0.881 | 0.0571 | 0.070 [0.065–0.076] |
| <b>Romania</b> ( $n = 424$ )         | 4.153 [194]          | 0.943 | 0.925 | 0.0578 | 0.086 [0.080–0.093] |
| <b>Netherlands</b> ( $n = 352$ )     | 2.081 [194]          | 0.958 | 0.945 | 0.0384 | 0.055 [0.048–0.063] |
| <b>Australia</b> ( $n = 334$ )       | 1.807 [194]          | 0.962 | 0.950 | 0.0368 | 0.049 [0.041–0.057] |
| <b>Turkey</b> ( $n = 306$ )          | 4.127 [194]          | 0.923 | 0.900 | 0.0528 | 0.101 [0.094–0.109] |
| <b>Russia</b> ( $n = 265$ )          | 2.657 [194]          | 0.955 | 0.941 | 0.0454 | 0.079 [0.071–0.088] |
| <b>Japan</b> ( $n = 240$ )           | 2.242 [194]          | 0.904 | 0.875 | 0.0681 | 0.072 [0.063–0.081] |
| <b>Israel</b> ( $n = 222$ )          | 1.604 [194]          | 0.958 | 0.945 | 0.0438 | 0.052 [0.041–0.063] |

Normed  $\chi^2$  Normed chi-square, having adequate fit with values  $\leq 5.0$ ; CFI Comparative Fit Index, having adequate fit with values  $\geq 0.90$ ; TLI Tucker Lewis Index, having adequate fit with values  $\geq 0.90$ ; SRMR Root-Mean Squared Residual having adequate fit with values  $\leq 0.08$ ; RMSEA Root-Mean Square Error of Approximation having adequate fit with values  $\leq 0.08$ , *df* degrees of freedom, 90 CI 90 percent confidence interval.

instance,  $\Delta CFI/\Delta TLI \leq 0.02$ ;  $\Delta RMSEA \leq 0.03$ ), under which metric invariance was supported. However, scalar invariance was not achieved in the single-model solution.

After concluding metric MI for the single model, we proceeded with a country-by-country analysis to scrutinise MI across individual countries (Supplement 1). All countries demonstrated consistent measurement properties with the overall model (partial/full scalar invariance) (Table 4).

In most countries, cultural differences were observed in the domains of Community Support and Health Services (with one or more intercepts relaxed for items 13–17), Social Participation (with one or more intercepts relaxed for items 3–6), and Civic Participation and Employment (with the intercept of item 9 relaxed). The domain of Transportation demonstrated full scalar invariance across all countries. It is important to note that because partial scalar invariance was observed in *some* domains between *some* countries, valid comparisons can be made across countries on the domains having full scalar invariance (Supplement 1). Moreover, notwithstanding the partial scalar invariance that was found for some domains between countries, consequential juxtapositions of latent mean scores can also be conducted on these domains. The scientific literature proposes that full scalar invariance is not obligatory for significant scrutiny, assuming that a minimum of two items of the instrument remain invariant (Vandenberg and Lance, 2000; Steenkamp and Baumgartner, 1998).

## Reliability of the AFCCQ

The composite reliability of the data across nine domains in ten countries shows a general adherence to acceptable reliability standards (Table 5). Romania and Russia stand out for their particularly high reliability scores across most domains. Romania's scores are high on the domains of Communication and Information (0.957), Community Support and Health Services (0.962), and Financial Situation (0.969). The Russian version of the AFCCQ demonstrates strong reliability particularly in the domain of Civic Participation and Employment, with a score of 0.924, which is in contrast with other countries scoring low reliability on this domain indicating issues with the consistency of responses or the domain's relevance in these countries. Other domains consistently posted acceptable to high reliability scores for all countries, affirming the robustness of the AFCCQ in capturing the age-friendliness of the studied environments.

This variation in reliability scores across different domains and countries underscores the influence of cultural and societal factors on the questionnaire responses and highlights the necessity for contextual adaptations in international survey applications. Despite these variations, the overall data confirms that the AFCCQ can be used reliably as an instrument for assessing age-friendly environments in diverse settings.

**Table 3** Level of measurement invariance between the 10 countries (single model solution).

|               | Normed $\chi^2$ [df] | CFI          | $\Delta$ CFI  | SRMR          | $\Delta$ SRMR | RMSEA [90% CI]             | $\Delta$ RMSEA | TLI          |
|---------------|----------------------|--------------|---------------|---------------|---------------|----------------------------|----------------|--------------|
| Configural    | 2.722 [1940]         | 0.945        | -             | 0.0384        | -             | 0.019 [0.019–0.020]        | -              | 0.928        |
| <b>Metric</b> | <b>3.107 [2066]</b>  | <b>0.930</b> | <b>-0.015</b> | <b>0.0559</b> | <b>0.0175</b> | <b>0.024 [0.023–0.025]</b> | <b>0.005</b>   | <b>0.914</b> |
| Scalar        | 4.810 [2264]         | 0.857        | -0.073        | 0.0582        | 0.0023        | 0.029 [0.028–0.029]        | 0.005          | 0.840        |

*CFI* Comparative Fit Index, having adequate fit with values  $\geq 0.90$ , *TLI* Tucker Lewis Index, having adequate fit with values  $\geq 0.90$ , *SRMR* Root-Mean Squared Residual having adequate fit with values  $\leq 0.08$ , *RMSEA* Root-Mean Square Error of Approximation having adequate fit with values  $\leq 0.08$ ;  $\chi^2$  Chi-square; df=degrees of freedom; *90% CI* 90 percent confidence interval.

## Global comparison of the AFCCQ results

All of the participating countries showed positive values for the AFCCQ-total score, indicating that participants find their city or community age-friendly, although there is room for improvement because the mean scores range from neutral to slightly satisfied in Turkey (mean score 5.1) to satisfied in Poland (mean score 19.0) with the age-friendliness of the city they live in. However, these values do not reflect the perceptions of older people on various domains of the AFCCQ (Table 6).

The independent-samples Kruskal-Wallis *H*-test showed significant differences ( $p < 0.001$ ) in the distribution of scores across all nine domains of the AFCCQ, as well as the AFCCQ-total score. Detailed pairwise comparisons conducted using Dunn's test are presented in Table 7 to elucidate specific differences between pairs of countries regarding the ranks or distributions of total AFCCQ scores. These findings demonstrate significant variations in ranks among most countries. Notably, the group comprising the Netherlands, Australia, Russia and Israel did not exhibit significant differences from each other in terms of the AFCCQ-total score. Similarly, no significant differences were found among the countries of North Macedonia, Turkey, and Japan. This suggests that the distribution of scores between these countries is similar, or not significantly different from each other.

## Discussion

The AFCCQ has been validated across ten countries, demonstrating its effectiveness in assessing age-friendliness within diverse urban environments. Through a robust methodological approach that employed both a single-model analysis and detailed country-by-country evaluations, the study confirmed the (partial) scalar invariance of the AFCCQ across different cultural and linguistic contexts (Supplement 1). This finding establishes the AFCCQ as a valid and reliable tool for international application in urban age-friendliness assessments. Moreover, the study's findings suggest that the AFCCQ can adapt to different cultural interpretations without losing its core functional integrity. This adaptability is crucial for a tool used across various global settings. By establishing a baseline of comparability and then exploring regional specifics, the AFCCQ demonstrates a framework for understanding how age-friendliness is perceived across different cultures. Compared to existing tools, which often do not account for such wide-ranging cultural differences (Plouffe and Kalache, 2010; World Health Organization, 2021). The AFCCQ tool affords a nuanced, scalable metric for policymakers and researchers alike to facilitate the inclusion of quantitative data from older people themselves into long-term strategy and resource planning at local and national policy levels, alongside the suggested methods of geocoded maps and qualitative approaches mentioned in the publication "Decade of Healthy Ageing: Baseline Report" by the WHO (World Health Organization, 2021).

The successful cross-cultural validation of the AFCCQ supports the adaptability of assessment tools in urban planning, reinforcing the idea that age-friendliness can be measured with a standard instrument that accommodates local cultural nuances. However, this requires that the instrument is founded on a robust theoretical framework, utilizes strong methods incorporating both qualitative and quantitative approaches, involves the target population from the very beginning, and is designed with the explicit goal of being valid beyond its initial context or culture

**Table 4** Level of measurement invariance country-by-country (between parentheses are the intercepts being relaxed in the model).

|                                          | Italy                                             | Poland                                    | North Macedonia                              | Romania                                | The Netherlands                            | Australia                                       | Turkey                                 | Russia                             | Japan                          |
|------------------------------------------|---------------------------------------------------|-------------------------------------------|----------------------------------------------|----------------------------------------|--------------------------------------------|-------------------------------------------------|----------------------------------------|------------------------------------|--------------------------------|
| <b>Italy</b> ( <i>n</i> = 1213)          |                                                   |                                           |                                              |                                        |                                            |                                                 |                                        |                                    |                                |
| <b>Poland</b> ( <i>n</i> = 801)          | Partial scalar invariance (1, 9, 13, 15)          | -                                         | -                                            | -                                      | -                                          | -                                               | -                                      | -                                  | -                              |
| <b>North Macedonia</b> ( <i>n</i> = 502) | Partial scalar invariance (13, 14, 15, 17)        | Partial scalar invariance (3, 13, 17, 22) |                                              | -                                      | -                                          | -                                               | -                                      | -                                  | -                              |
| <b>Romania</b> ( <i>n</i> = 424)         | Partial scalar invariance (3, 4, 13, 15, 17)      | Partial scalar invariance (3, 9, 22)      | Partial scalar invariance (9, 14)            |                                        | -                                          | -                                               | -                                      | -                                  | -                              |
| <b>The Netherlands</b> ( <i>n</i> = 352) | Partial scalar invariance (13)                    | Partial scalar invariance (1, 13, 17, 22) | Full scalar invariance                       | Full scalar invariance                 |                                            | -                                               | -                                      | -                                  | -                              |
| <b>Australia</b> ( <i>n</i> = 334)       | Partial scalar invariance (13, 16, 17)            | Partial scalar invariance (1, 17, 18)     | Partial scalar invariance (3)                | Partial scalar invariance (4, 18)      | Partial scalar invariance (11)             |                                                 | -                                      | -                                  | -                              |
| <b>Turkey</b> ( <i>n</i> = 306)          | Partial scalar invariance (9, 13, 17, 22)         | Partial scalar invariance (22)            | Partial scalar invariance (3, 14)            | Partial scalar invariance (9)          | Partial scalar invariance (9)              | Partial scalar invariance (4, 9, 16)            |                                        | -                                  | -                              |
| <b>Russia</b> ( <i>n</i> = 265)          | Partial scalar invariance (13)                    | Partial scalar invariance (1, 13, 17)     | Full scalar invariance                       | Full scalar invariance                 | Full scalar invariance                     | Full scalar invariance                          | Partial scalar invariance (13)         |                                    | -                              |
| <b>Japan</b> ( <i>n</i> = 240)           | Partial scalar invariance (7, 13, 14, 16, 17, 22) | Partial scalar invariance (1, 16, 17, 22) | Partial scalar invariance (1, 3, 13, 16, 17) | Partial scalar invariance (14, 16, 17) | Partial scalar invariance (7, 14, 16, 17)  | Partial scalar invariance (4, 5, 7, 14, 17, 22) | Partial scalar invariance (14, 16, 17) | Partial scalar invariance (15, 17) |                                |
| <b>Israel</b> ( <i>n</i> = 222)          | Partial scalar invariance (13, 16, 17)            | Partial scalar invariance (15, 16, 17)    | Partial scalar invariance (15, 17)           | Partial scalar invariance (15, 17)     | Partial scalar invariance (14, 15, 16, 17) | Partial scalar invariance (17)                  | Partial scalar invariance (15, 16, 17) | Partial scalar invariance (15)     | Partial scalar invariance (22) |

Item numbers refer to the AFCCQ questionnaire item numbering and correspond to the following domains: Housing (Items 1–2), Social participation (3–6), Respect and social inclusion (7–8), Civic participation and employment (9–10), Communication and information (11–12), Community support and health services (13–17), Outdoor spaces and buildings (18–19), Transportation (20–21), and Financial situation (22–23).

**Table 5** Composite reliability of the AFCCQ.

|                                          | Housing | Social participation | Respect and social inclusion | Civic Participation And Employment | Communication and information | Community support and health services | Outdoor Spaces and Buildings | Transportation | Financial Situation |
|------------------------------------------|---------|----------------------|------------------------------|------------------------------------|-------------------------------|---------------------------------------|------------------------------|----------------|---------------------|
| <b>Italy</b> ( <i>n</i> = 1213)          | 0.717   | 0.780                | 0.708                        | <b>0.390</b>                       | 0.696                         | 0.783                                 | 0.667                        | 0.850          | 0.819               |
| <b>Poland</b> ( <i>n</i> = 801)          | 0.786   | 0.779                | 0.790                        | <b>0.540</b>                       | 0.777                         | 0.832                                 | 0.738                        | 0.745          | 0.892               |
| <b>North Macedonia</b> ( <i>n</i> = 502) | 0.877   | 0.773                | 0.769                        | <b>0.605</b>                       | 0.873                         | 0.810                                 | 0.812                        | 0.866          | 0.927               |
| <b>Romania</b> ( <i>n</i> = 424)         | 0.866   | 0.926                | 0.923                        | <b>0.658</b>                       | 0.957                         | 0.962                                 | 0.935                        | 0.871          | 0.969               |
| <b>The Netherlands</b> ( <i>n</i> = 352) | 0.859   | 0.913                | 0.901                        | 0.738                              | 0.787                         | 0.874                                 | 0.811                        | 0.888          | 0.963               |
| <b>Australia</b> ( <i>n</i> = 334)       | 0.754   | 0.878                | 0.837                        | <b>0.697</b>                       | 0.852                         | 0.865                                 | 0.772                        | 0.903          | 0.926               |
| <b>Turkey</b> ( <i>n</i> = 306)          | 0.905   | 0.926                | 0.900                        | <b>0.621</b>                       | 0.957                         | 0.963                                 | 0.969                        | 0.967          | 0.929               |
| <b>Russia</b> ( <i>n</i> = 265)          | 0.922   | 0.934                | 0.759                        | 0.924                              | 0.957                         | 0.953                                 | 0.943                        | 0.973          | 0.950               |
| <b>Japan</b> ( <i>n</i> = 240)           | 0.919   | 0.728                | <b>0.662</b>                 | <b>0.613</b>                       | 0.834                         | 0.770                                 | 0.821                        | 0.952          | 0.860               |
| <b>Israel</b> ( <i>n</i> = 222)          | 0.831   | 0.857                | 0.718                        | 0.730                              | 0.819                         | 0.845                                 | 0.853                        | 0.920          | 0.939               |

**Table 6** Normalised AFCCQ scores per domain per country (ranging from −10 to +10), mean (SD).

|                                             | Italy<br>( <i>n</i> = 1213) | Poland<br>( <i>n</i> = 801) | North<br>Macedonia<br>( <i>n</i> = 502) | Romania<br>( <i>n</i> = 424) | The<br>Netherlands<br>( <i>n</i> = 352) | Australia<br>( <i>n</i> = 334) | Turkey<br>( <i>n</i> = 306) | Russia<br>( <i>n</i> = 265) | Japan<br>( <i>n</i> = 240) | Israel<br>( <i>n</i> = 222) |
|---------------------------------------------|-----------------------------|-----------------------------|-----------------------------------------|------------------------------|-----------------------------------------|--------------------------------|-----------------------------|-----------------------------|----------------------------|-----------------------------|
| Housing                                     | 5.7 (3.0)<br>(+++)          | 6.8 (3.6)<br>(+++)          | 6.2 (3.9)<br>(+++)                      | 4.7 (3.8)<br>(++)            | 6.8 (3.9)<br>(+++)                      | 7.4 (3.3)<br>(+++)             | 1.5 (4.8)<br>(+)            | 4.8 (5.7)<br>(++)           | 3.0 (5.3)<br>(++)          | 6.5 (4.1)<br>(+++)          |
| Social<br>participation                     | 2.5 (3.8)<br>(++)           | 3.6 (3.8)<br>(++)           | 1.7 (3.7)<br>(+)                        | 3.6 (3.8)<br>(++)            | 2.5 (4.0)<br>(++)                       | 3.4 (4.0)<br>(++)              | 0.3 (4.5)<br>(+)            | 3.5 (5.9)<br>(++)           | 2.0 (3.6)<br>(+)           | 4.5 (3.8)<br>(++)           |
| Respect and social<br>inclusion             | 5.9 (3.5)<br>(+++)          | 5.2 (4.9)<br>(+++)          | 1.4 (5.7)<br>(+)                        | -1.6 (5.3)<br>(-)            | 6.2 (4.0)<br>(+++)                      | 0.9 (5.2)<br>(+)               | 0.3 (4.7)<br>(+)            | 6.8 (5.3)<br>(+++)          | 3.4 (4.7)<br>(++)          | -0.1<br>(4.4)<br>(-)        |
| Civic participation<br>and employment       | 3.6 (3.4)<br>(++)           | 4.1 (4.1)<br>(++)           | 1.9 (4.5)<br>(+)                        | 2.0 (4.7)<br>(+)             | 3.7 (3.8)<br>(++)                       | 2.2 (4.5)<br>(+)               | 0.7 (4.4)<br>(+)            | 4.9 (5.7)<br>(++)           | 3.4 (4.1)<br>(++)          | 4.3 (3.7)<br>(++)           |
| Communication<br>and information            | 1.9 (4.4)<br>(+)            | 3.6 (4.6)<br>(++)           | 0.5 (5.1)<br>(+)                        | 1.9 (5.3)<br>(+)             | 3.8 (3.8)<br>(++)                       | 4.5 (3.9)<br>(++)              | 1.1 (5.0)<br>(+)            | 3.3 (6.5)<br>(++)           | 3.8 (4.2)<br>(++)          | 5.1 (4.2)<br>(+++)          |
| Community<br>support and health<br>services | 1.0 (4.0)<br>(+)            | 3.6 (3.6)<br>(++)           | 0.9 (3.9)<br>(+)                        | 3.2 (4.7)<br>(++)            | 2.6 (3.2)<br>(++)                       | 2.3 (3.8)<br>(+)               | 1.8 (4.8)<br>(+)            | 1.6 (6.3)<br>(+)            | 0.5 (3.3)<br>(+)           | 2.4 (3.6)<br>(+)            |
| Outdoor spaces<br>and buildings             | 1.4 (4.7)<br>(+)            | 3.5 (4.4)<br>(++)           | -1.2 (5.6)<br>(-)                       | 3.0 (4.7)<br>(++)            | 2.0 (4.3)<br>(+)                        | 1.8 (4.6)<br>(+)               | 1.0 (5.1)<br>(+)            | 0.7 (6.8)<br>(+)            | -2.0 (4.5)<br>(-)          | 1.5 (4.8)<br>(+)            |
| Transportation                              | 3.9 (4.4)<br>(++)           | 5.6 (4.1)<br>(+++)          | 2.3 (5.6)<br>(+)                        | 2.6 (5.2)<br>(++)            | 4.3 (4.5)<br>(++)                       | 3.6 (5.2)<br>(++)              | 0.9 (5.2)<br>(+)            | 3.7 (6.7)<br>(++)           | 3.2 (5.9)<br>(++)          | 4.3 (4.9)<br>(++)           |
| Financial situation                         | 2.8 (4.5)<br>(++)           | 2.0 (5.4)<br>(+)            | 1.3 (5.6)<br>(+)                        | 0.9 (6.6)<br>(+)             | 3.9 (4.8)<br>(++)                       | 3.2 (5.2)<br>(++)              | 1.5 (4.9)<br>(+)            | 0.1 (6.4)<br>(+)            | 2.3 (4.8)<br>(+)           | 3.8 (4.9)<br>(++)           |

(Dikken et al., 2020). These conditions are essential to ensure that the tool not only respects but also accurately reflects the diverse realities of different populations, making it effective in enhancing urban environments for older people worldwide. The adaptability of the AFCCQ can help to develop targeted interventions that are culturally appropriate and effective in enhancing the quality of life for older people (van Hoof and Marston, 2021).

The AFCCQ emerges as a useful instrument for policymakers at both global, national and regional levels, including those within the World Health Organization, to enhance their strategies for creating more inclusive urban environments for older people. As a validated tool with the ability to gauge age-friendliness across diverse national contexts, the AFCCQ equips policymakers with precise data that can inform the development and refinement of health and social policies. This enables a focused approach to addressing specific needs and challenges related to ageing populations within different regions (van Hoof and Marston, 2021). For instance, by identifying key areas of strength and weakness across various domains of age-friendliness, such as housing, transportation, and social inclusion, policymakers can prioritise investments and interventions that directly impact the well-being of older citizens (Buffel et al., 2019). However, it is important to note that partial scalar invariance indicates that most item intercepts are comparable across countries, but a subset shows systematic country-specific shifts. Practically, this means that cross-country comparisons of mean levels are best based on latent means estimated in a multi-group CFA framework that frees the non-invariant intercepts, and interpreted as reflecting the invariant part of the scale. In contrast, comparisons based on observed domain or total scores may still contain residual bias from the non-invariant items, making small differences and country rankings less reliable; cross-country findings are, therefore, best complemented by local contextual evidence when informing policy choices. However, at a global level, the WHO can utilise the AFCCQ to set benchmarks and monitor progress towards the goals set by its GNAFCC. This not only aids in achieving a higher standard of living for older adults but also promotes a sustainable and scalable model of development that other cities and nations can emulate (World Health Organization, 2018). Therefore, the AFCCQ can serve not just as a tool for assessment but also as a roadmap guiding policymakers towards more effective and targeted age-friendly policies.

**Table 7** Pairwise comparisons using Dunn's test to identify specific differences between pairs of countries on Total AFCCQ scores.

|                                          | Italy                | Poland              | North Macedonia     | Romania             | The Netherlands     | Australia           | Turkey              | Russia              | Japan               |
|------------------------------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| <b>Italy</b> ( <i>n</i> = 1213)          |                      | -                   | -                   | -                   | -                   | -                   | -                   | -                   | -                   |
| <b>Poland</b> ( <i>n</i> = 801)          | <i>p</i> = 0.000**   |                     | -                   | -                   | -                   | -                   | -                   | -                   | -                   |
| <b>North Macedonia</b> ( <i>n</i> = 502) | <i>p</i> ≤ 0.001***  | <i>p</i> = 0.000**  |                     | -                   | -                   | -                   | -                   | -                   | -                   |
| <b>Romania</b> ( <i>n</i> = 424)         | <i>p</i> = 0.108     | <i>p</i> = 0.000**  | <i>p</i> ≤ 0.001*** |                     | -                   | -                   | -                   | -                   | -                   |
| <b>The Netherlands</b>                   | <i>p</i> ≤ 0.001***  | <i>p</i> = 0.005**  | <i>p</i> = 0.000**  | <i>p</i> ≤ 0.001*** |                     | -                   | -                   | -                   | -                   |
| <b>Australia</b> ( <i>n</i> = 334)       | <i>p</i> = 0.054     | <i>p</i> ≤ 0.001*** | <i>p</i> ≤ 0.001*** | <i>p</i> = 0.004**  | <i>p</i> = 0.022    |                     | -                   | -                   | -                   |
| <b>Turkey</b> ( <i>n</i> = 306)          | <i>p</i> ≤ 0.001***  | <i>p</i> = 0.000**  | <i>p</i> = 0.994    | <i>p</i> ≤ 0.001*** | <i>p</i> = 0.000**  | <i>p</i> ≤ 0.001*** |                     | -                   | -                   |
| <b>Russia</b> ( <i>n</i> = 265)          | <i>p</i> = 0.013     | <i>p</i> ≤ 0.001*** | <i>p</i> ≤ 0.001*** | <i>p</i> ≤ 0.001*** | <i>p</i> = 0.123    | <i>p</i> = 0.553    | <i>p</i> ≤ 0.001*** |                     | -                   |
| <b>Japan</b> ( <i>n</i> = 240)           | <i>p</i> = <0.001*** | <i>p</i> = 0.000**  | <i>p</i> = 0.171    | <i>p</i> = 0.005**  | <i>p</i> ≤ 0.001*** | <i>p</i> ≤ 0.001*** | <i>p</i> = 0.215    | <i>p</i> ≤ 0.001*** |                     |
| <b>Israel</b> ( <i>n</i> = 222)          | <i>p</i> ≤ 0.001***  | <i>p</i> = 0.004**  | <i>p</i> = 0.000**  | <i>p</i> ≤ 0.001*** | <i>p</i> = 0.643    | <i>p</i> = 0.120    | <i>p</i> ≤ 0.001*** | <i>p</i> = 0.345    | <i>p</i> ≤ 0.001*** |

\*\*\**p* = <0.001, \*\**p* = <0.005.

The initial use of a single model across all participating countries served as a critical first step to establish a baseline of comparability. By confirming that the questionnaire's structure was held across diverse settings, the study ensured that subsequent, more granular analyses would rest on a validated framework. This methodological choice aligns with recommendations from the literature on cross-cultural research, emphasizing the importance of establishing broad comparability before addressing finer nuances and specificities (van de Schoot et al., 2012; Byrne et al., 1989). Following the single model validation, the country-by-country analysis provided insights into specific local adaptations and needs. This detailed scrutiny allowed researchers to pinpoint where the AFCCQ might yield different interpretations, thereby enhancing its sensitivity and relevance to particular cultural contexts. Such an approach not only strengthens the tool's overall robustness but also enriches our understanding of how age-friendliness is perceived and valued differently across regions (Vandenberg and Lance, 2000; Steenkamp and Baumgartner, 1998).

Although the methodology used is rigorous, the variations in cultural context pose challenges, as evidenced by the differential domain scores across countries. These findings echo the complexities discussed in the literature regarding what constitutes age-friendliness; it can significantly differ from one cultural setting to another (Wang et al., 2021). This diversity suggests that while the AFCCQ provides a valuable standardised metric, its application might benefit from localised adjustments or supplementary tools that capture specific cultural or regional nuances as posited by Dikken et al. (2020), referring to the AFCCQ as a quick-scan. Moreover, it is relevant to note that samples from the Global South, including low-income areas of Africa and Asia, were not included in this study, meaning that cross-cultural comparisons with these regions are not yet possible. These regions, however, are also minimally represented in the WHO's GNAFCC. This may introduce a potential research bias since the greatest impact of ageing will occur in these regions, and services and infrastructure may not have been designed with older adults in mind. Finally, the age composition of the samples varied across countries. In particular, the datasets contributed by Japan and Russia originated from intergenerational community studies and therefore included substantial proportions of participants aged <50 years. Although partial scalar invariance was achieved, and the data were tested for differences between age groups in these countries, results show that more model adjustments were required for Japan (i.e., freeing a larger number of intercepts), indicating that age composition and/or contextual differences may have influenced the invariance results. Additionally, the relatively young age composition of the Russian sample may also partly explain the unusually high reliability observed for the domain of civic participation and employment. The extent to which these modifications reflect demographic versus cultural factors remains uncertain and should be examined in future work, ideally using age-stratified analyses and harmonised sampling strategies across countries.

The methodological framework employed in this study sets a precedent for future studies on global age-friendliness, advocating for a balanced approach that combines universal assessment tools with context-sensitive adaptations. Such methodologies are pivotal in advancing our understanding of urban ageing and fostering environments that support healthy and active ageing across the globe.

As this is the first instrument designed to measure age-friendly cities comprehensively and the first to attempt cross-cultural comparisons, the age-friendly cities and communities movement currently lacks quantitative data on the long-term effects of age-friendly policies. However, results from this study demonstrate that the AFCCQ could be of added value, and longitudinal studies should be encouraged to assess how changes in policy affect older adults' perceptions of their age-friendly city over time. Following the WHO's recommendation of a five-year cycle for reassessing age-friendly initiatives, such studies could provide valuable insights into the lasting impacts of age-friendly cities and communities' policies and adaptations. Additionally, expanding the research to include more diverse urban and rural settings could further validate the AFCCQ's effectiveness and lead to its refinement, ensuring it remains a relevant and powerful tool for global age-friendliness assessments. Finally, and in addition to the quantitative data provided by AFCCQ, it is essential for policymakers to consider a broader array of data sources when implementing political decisions and shaping policies. While the AFCCQ offers valuable insights into the age-friendliness of urban environments, relying solely on these metrics may overlook critical aspects of older adults' experiences and needs that are less easily quantified. Incorporating qualitative assessments, anecdotal evidence, and case studies will provide a more comprehensive understanding, together with quantified evidence of the local context, and future investigations should employ these approaches founded in sound, evidence-based literature (van Hoof et al., 2021; Buitendijk et al., 2025; Dikken et al., 2026). This multifaceted approach ensures that policies are not only

informed by standardised data but are also responsive to the nuanced realities of community life, ultimately leading to more effective and inclusive age-friendly interventions (van Hoof et al., 2021; World Health Organization, 2026b).

This study validated the AFCCQ's applicability across a broad geographic and cultural spectrum, but it also provides initial multi-country evidence to support the AFCCQ's use for cross-national assessment within the included settings for assessing and enhancing age-friendliness. The findings are novel in the context of addressing research techniques and are relevant for driving forward the agenda of creating inclusive, supportive, identifying outcomes, and adaptable age-friendly environments for ageing populations worldwide. This work is founded on rigorous design and methodology to investigate and set out a novel technique to afford best practices (World Health Organization, 2026b; Decade of Healthy Ageing, 2026; European Commission, 2016) in the context of age-friendly practices and policies. The analysis and outcomes provide a multi-user dataset to afford researchers, policymakers and global agencies such as the World Health Organization, the United Nations through the Decade of Healthy Ageing and the European Commission a data-rich resource, aligned to their respective directives and initiatives. Further, these datasets at both site level and combined afford researchers in the disciplines of urban planning, social science, and gerontology the opportunity to conduct their own investigations and drive innovative and cutting research, which is key to employing changes in this field of research, encouraging a nuanced blend of global standards and local adaptations.

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**Data availability** The authors confirm that all data generated or analysed during this study are included in this published article. This dataset is made available for validation, replication, and secondary analysis purposes under a Creative Commons Attribution 4.0 International license (CC BY 4.0). Users are requested to properly cite the main publication when utilizing this dataset.

## Declarations

**Competing interests** The authors declare no competing interests.

**Ethical approval and consent to participate** The project was based on a secondary data analysis of existing datasets, which all received approval from institutional review boards (Israel, Bar-Ilan University May 2023 #042303; Romania, the Netherlands and Poland, *Certification of Ethical Acceptability for Research Involving Human Subjects* was obtained from the Ethic Committee at the National University of Political Studies and Public Administration on 23 May 2022, for the three countries of jointly; North Macedonia, Mother Teresa University, 13 January 2023 (certificate number 03–29/1); Italy, Ca’ Foscari University of Venice, 6 November 2023 (Verbale N. 10/2023); Australia, UniSA Human Research Ethics Committee (Protocol 205241) in February 2023; Russia, Ethics Committee of the ICDC, numbered 133, 6 July 2023; Japan, Nagoya Institute of Technology (Receipt number 2021-2 and date of notification: 1 June 2021); Turkey, Ethics Committee of a Foundation University (2020/12 issue) for the research.

**Informed consent** Survey consent was explicit; at the time of participation, respondents confirmed that they understood the purpose of the research before starting, using the yes/no options. The scope of the consent included the participation itself, the use of the data by the research team and consent to publish. All participants have been fully informed that their anonymity is assured (i.e., fully unknown to the researchers and authors of this paper). Moreover, they have been informed about the reasons why the research was being conducted, how data were to be utilised, and if there were any risks to them of participating.

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