



Measurement invariance and country difference in death anxiety: evidence from portuguese and arab samples

Gabriela Gonçalves^{1,2} · Saeed A. AL-Dossary³ · Cátia Sousa^{1,2} 

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Abstract

Death is something inevitable and common to all human beings. However, cultures vary in how they define and manage living with the inevitability of death and what happens when a person dies. Among the possible responses to this inescapable reality, there is death anxiety. Several instruments have proliferated in the literature to assess death anxiety. Among them, stands out the Scale of Death Anxiety (SDA) which contemplates somatic, cognitive, emotional and behavioural reactions from a symptomatic perspective. Thus, the objective of this study is the validation and measurement invariance of the SDA in Portuguese and Arab samples (N=216 and N=377, respectively). Confirmatory factor analyses, multi-group confirmatory factor analyses measurement invariance and latent mean differences were performed across cultures and gender groups. Our results provided important preliminary evidence for the validity of the scale in both samples. The structure of the SDA remained unchanged in both cultures and genders. The SDA showed partial scalar invariance across cultural groups, and full scalar invariance across gender groups. As expected, the Arab participants showed higher levels of anxiety than the Portuguese sample. The analyses also showed that females in both cultural groups obtained higher scores than males on dysphoria and fear of death. However, the two genders did not differ significantly on avoidance of death. The results show that the SDA is a reliable and valid measure for the study of death anxiety, showing to be invariant between cultures and between genders.

Keywords Death anxiety · SDA · Measurement invariance · Latent means differences · Psychometric properties

Introduction

The only certainty is death.
Guy de Maupassant.

Although recognition of the fact that the fear of death is universal dates to Hall's work in 1896, several approaches have been adopted in recent years with a view to developing instruments to measure the different dimensions of death

anxiety (Thorson & Powell, 1992). In addition to the different and possible definitions attributed to anxiety in the face of death and the different measurement instruments, the issue of cultural differences and the universality of the construct have also been under discussion (Moore & Williamson, 2003; Lehto & Stein, 2009; Becker, 1973) argued that the anxiety generated by knowing that death is inevitable is a universal psychological response. However, there is no consensus among scholars on whether death anxiety is universal or specific to religions and/or cultures (Pandya & Kathuria, 2021). The evidence indicates a mixed or inconclusive response, and Leming and Dickinson (2021) observed that not all cultures fear death, and the definition of death itself presents cultural variations (Pandya & Kathuria, 2021). The same happens with death anxiety, as several studies have shown differences between cultures (e.g. Ens & Bond 2007; Li et al., 2017; Park et al., 2012). For example, some studies have shown that Arab countries have higher levels of death anxiety than Western countries (e.g. Abdel-Khalek 2003, 2005).

✉ Cátia Sousa
cavsousa@ualg.pt

¹ University of Algarve, Campus da Penha, Faro
8005-139, Portugal

² Centre for Research in Psychology (CIP/UAL), University of
Algarve, Faro, Portugal

³ Psychology Department, College of Education, University of
Ha'il, Ha'il, Saudi Arabia

In this context, Cai and colleagues (2017) developed a multidimensional instrument to assess death anxiety, the Scale of Death Anxiety (SDA), which aims to measure not only psychological aspects of anxiety but also somatic aspects and dysphoria. As this is a recent instrument and the first to assess somatic components and dysphoria, which distinguishes it from the other existing scales, the psychometric properties of SDA in cultures other than Chinese culture are not yet known. Death anxiety is a common human experience, so its attenuation can play a vital role in improving the quality of life of individuals (Zhang et al., 2019), and being based on a symptomatic perspective, SDA creates a link between clinical and counselling diagnoses and psychological assessment, allowing the understanding of possible psychological disorders and the identification of effective therapies (Cai et al., 2017). Thus, the objective of this study is the validation and measurement invariance of the SDA (Cai et al., 2017) in two countries, Portugal and Saudi Arabia, with different cultural values. These cultural differences have been mentioned in several studies on death anxiety (e.g., collectivism vs. individualism, level of religiosity, type of religion (e.g., Li et al., 2018; Pandya & Kathuria, 2021)), therefore it is expected that there are differences in the levels of anxiety felt in the two countries. On the other hand, other investigations have also observed gender differences, with women feeling more anxiety about death compared to men (e.g., Abdel-Khalek, 2005). It is therefore expected to find differences in anxiety levels according to gender.

In summary, and given the growing recognition and importance of the transdiagnostic role of death anxiety in various contexts, not only in psychopathology and medicine, but also in organizational behaviors (e.g. experiencing grief, addictive behaviors at work), it is imperative that researchers, managers and clinicians are able to employ psychometrically valid and reliable tools to measure this construct (Zuccala et al., 2022).

Death anxiety

Two unavoidable facts that all humans share are birth and death (Gire, 2014). Despite this reality, most of us prefer not to contemplate the idea of reaching the ultimate end of our sojourn on earth. Thus, the most common response to the thought of one's own death, or the death of other loved ones, is fear. However, human beings have developed advanced and complex cognitive abilities that allow them to be self-aware and anticipate future results, that is, to make possible an awareness of the inevitability of death (Gire, 2014). Therefore, the conflict between the desire for self-preservation and awareness of the inevitability of death can lead

to feelings of anxiety and terror when we think about our mortality. Among the attitudinal constructs related to death, anxiety has received great attention in the literature (Nia et al., 2015; Nienaber & Goedereis, 2015; Rajabi et al., 2015).

Death is a complex physio-psychosocial event that can induce anxiety, so interest in this concept has proliferated in the literature (Kübler-Ross, 2014; Sarikayaa & Baloğlu, 2016). However, we cannot reference a single, consensual definition of this construct (Lehto & Stein, 2009; Belsky, 1999) defined death anxiety as the thoughts, fears and emotions about the last life event. Abdel-Khalek and Tomás-Sábado (2005) framed death anxiety as the fruit of awareness about death. For Dadfar and Lester (2017), death anxiety is a fear of the death of oneself as well as the fear of the death of others. Cai and colleagues (2017), however, refer to fear and anxiety as distinct theoretical constructs. Although fear and anxiety share emotional and behavioural consequences, fear emphasises negative emotional reactions to visible, specific events or true threats, while anxiety emphasises negative reactions to nonspecific, potential and distant threats (Vermetten et al., 2002). Yalom (1980) emphasised that fear of death is the basis of death anxiety and that everyone will feel fear of death. However, while some individuals mitigate this fear, using anxiety-buffers for example, others may express some pathological problems because of this conflict (Yetzer & Pyszczynski, 2019). For Li et al. (2018), death anxiety is not a sudden emotion but a continuous state throughout life, and the degree of death-related anxiety varies from person to person (Bengtson et al., 1977). A low degree of anxiety does not affect the lives of individuals, but when it becomes excessive, it can cause damage to physical and mental health (e.g., depression, schizophrenia, eating disorders and obsessive-compulsive disorder, among others) (Arndt et al., 2004; Chung et al., 2005; Li et al., 2018; Thorson & Powell, 2000).

Cultural variation in death anxiety

According to Gire (2014), although there is evidence of death anxiety in almost all societies, cultures vary widely in the magnitude to which it is expressed. For example, Western cultures tend to deny or defy death, displaying a strong aversion to the idea of dying (e.g., Kalish & Reynolds 1981). Eastern cultures, on the contrary, tend to better manage the idea of dying, being considered as cultures which affirm death, conceiving it as a transition and accepting it (Bulut, 2022; Gire, 2014; Lester et al., 2007; Li et al., 2017; Schumaker et al., 1988). One of the explanations for cultural differences in death anxiety stems from terror management theory (Solomon et al., 1991, 2004), which postulates that humans have a deep fear of death, and to deal with this fear, they created a series of worldviews, such as a belief in life

after death, to manage this anxiety (e.g., Piotrowski et al., 2020). Thus, religiosity as a cultural variable has received a lot of attention regarding the study of death anxiety, namely because people who come from cultures whose religious beliefs encompass a belief in life after death express less anxiety than those in which afterlife beliefs do not form an important part of religion (e.g., Gire 2014; Jong, 2021; Pandya & Kathuria, 2021).

The study of Mahabeer and Bhana (1984) indicated that although Muslim individuals were more anxious than Christians and Hindus, the degree of commitment to their own religious practices and beliefs did not intensify or reduce death anxiety, so the inconclusiveness of religiosity and death anxieties continue even in the current studies (Pandya & Kathuria, 2021). Other studies have also shown differences according to gender and or age (e.g. Adelirad et al., 2021; Ansari & Lankarani, 2016; Dadfar et al., 2021; Pierce et al., 2007; Saeed & Bokhary, 2016). Abdel-Khalek (2003), for example, noted significant differences between countries and between genders, attributing their cause to the cultural issues of individualism vs. collectivism (Hofstede, 1980; Triandis 1995) or to socially established differences in contrasting groups of countries. This author compared the death anxiety averages of Spain and five Arab countries (Egypt, Qatar, Kuwait, Lebanon and Syria), having observed that Spain had lower averages. In another study, which included countries such as Egypt, Kuwait, Lebanon, Syria, USA, Spain and Britain, it was observed that, in addition to the lower means in Western countries, women also had higher means of obsession with death compared to men (Abdel-Khalek, 2005), differences that Tomás-Sábado and Gómez-Benito (2004) pointed out as being the result of a similar concept, anxiety about death, including religiosity, the cultural meaning that is attributed to death as well as the quality of life. Also, Saleem and Saleem (2020) observed that Muslim women were more death anxiety than men, a situation that the authors attributed to the fact that male members of society have more freedom to enjoy their social status through achievements that can give them a sense of symbolic immortality, while female members are not strongly encouraged to have jobs or to enjoy a social life, which can make women more sensitive about their mortality. Furthermore, Abdel-Khalek (2005) argued that men are socialised not to reveal their emotions, so it can be speculated that the expression of fear of death or death anxiety may be opposed to male norms; thus, they show less death anxiety (e.g., Abdel-Khalek & Alansari 2004; Kastenbaum, 2000).

The literature has shown that death is something complex and can have different meanings for different people (Karasu, 1985). People with different experiences, cultures and social status may have different attitudes towards death

(Li et al., 2018). Even within the same culture, there can be subtle differences between different groups. In this sense, death anxiety measurement instruments may have different structures (Li et al., 2018) and cross-cultural comparisons of death anxiety may not meet the construct validity and existential validity (Beshai, 2008). To ensure that the measurement instruments are valid and to ensure the comparability of the properties measured in different groups of respondents, it is necessary that the scales have good psychometric invariance as well as a clear structure (Li et al., 2018).

Death anxiety measures

Over the last few decades, several scales to measure death anxiety have been developed. According to Thorson and Powell (1992), several authors have approached death anxiety as a one-dimensional construct, for example, Bengtson et al. (1977), Cuellar and Ragan (1977), Kalish (1985) and Templer (1970). Most, however, have adopted the approach that several different factors or elements make up this construct (Thorson & Powell, 1992). Among the various instruments stand out the Death Anxiety Scale (DAS) by Templer (1970), the Revised Death Anxiety Scale (Thorson & Powell, 1992), the Death Anxiety Inventory (DAI) by Tomás-Sábado and Gómez-Benito (2005), the Arabic Scale of Death Anxiety (ASDA) by Abdel-Khalek (2004), the Chinese Death Anxiety Inventory (Wu et al., 2003), and the Death Anxiety Scale-Extended (DASE) by Templer et al. (2006). One of the most used scales is Templer's DAS (1970), composed of 15 items with a dichotomous format of True/False, having been translated into several languages (e.g., Afrikaans, Arabic, Chinese, Dutch, German, Hindi, Italian, Portuguese, Japanese, Korean and Spanish) (Lester et al., 2007; Lonetto & Templer, 1986).

More recently, new measurement instruments have emerged, including the Turkish Death Anxiety Scale (TDAS) by Sarikaya and Baloglu (2016) and the SDA by Cai et al. (2017). The SDA (Cai et al., 2017) was developed with the aim of filling some gaps in existing instruments: (1) the fact that most existing scales measure apprehension about specific events (e.g. cognition and emotion) related to death, with few of them including assessments of individuals' physical reactions, a characteristic that is central to the nature of anxiety (Cai et al., 2017); 2) the non-distinction between fear and anxiety since they are configured as distinct constructs, and, as such, it is necessary that the instrument reflects unique characteristics of anxiety, such as avoiding things or events associated with death as well as dysphoria and somatic reactions related to anxiety (Cai et al., 2017); 3) in addition to fear of death, and although some measures of death anxiety include antecedent components that influence anxiety and factors that reflect an individual's

attitude toward death, these factors are less related to the nature and characteristics of death anxiety itself (Cai et al., 2017). Given these gaps, Cai and colleagues (2017) developed SDA as a multidimensional construct that measures not only psychological components but also somatic symptoms and dysphoria.

The SDA includes 17 items that assess four dimensions: (1) dysphoria – emphasises the somatic component of death anxiety, alluding to feelings such as being tired, upset and emotionally isolated when thinking about death; (2) death intrusion – emphasises the cognitive component of death anxiety, referring to intrusive nightmares, images and thoughts related to death itself; (3) fear of death – associated with the emotional component of death anxiety, referring to feelings related to the fear of death, along with emotional and somatic symptoms; and (4) avoidance of death – related to the behavioural component of death anxiety and associated with the avoidance of death-related thoughts, situations, events and experiences. The SDA is the first death anxiety scale that includes the constructs of dysphoria and somatic symptoms, showing good psychometric properties in a Chinese sample (Cai et al., 2017).

On account of this, and since it is an instrument that distinguishes the concepts of fear and anxiety, which includes a psychological aspect and also a somatic and dysphoric aspect of anxiety in the face of death, this scale presents itself as a reliable and valid measure in the study of death anxiety. As it is a recent scale, there are still no validation studies for other populations. As indicated by its authors, the SDA was developed using limited samples, and it is not clear whether it is an invariant instrument between cultures, time and/or age, so there is a need to replicate the four-factor structure of the SDA in other samples with different cultures (Cai et al., 2017). Thus, the aim of this study was to validate the SDA for the Portuguese and Arab populations as well as to present its psychometric properties in terms of its measurement invariance and latent differences in means.

Methodology

Sample

This study used a convenience sample composed of 565 participants. The final sample resulted in 216 Portuguese and 377 Arab participants of both genders, aged between 18 and 61 years ($M=25.54$, $SD=8.37$).

Portuguese sample

The Portuguese sample ($N=216$) was composed of 60 male and 156 female participants, with an average age of 27.07

($SD=10.19$). Most were single ($n=157$, 72.2%) and were working towards a degree ($n=146$, 67.6%).

Arab sample

The Saudi Arabian sample was composed of 377 participants, of which 128 were male and 249 were female, with an average age of 24.75 ($SD=6.59$). Most respondents were single ($n=294$) and were working towards a degree ($n=310$, 82.2%).

Instrument

The Scale of Death Anxiety (SDA), originally developed in Chinese by Cai and colleagues (2017), was used. It is an instrument composed of 17 items that focus on how an individual can feel and perceive when thinking about their own death and dying. It is a multidimensional scale that assesses four dimensions: dysphoria (five items, e.g. “In the past month, whenever thinking of death, I have often gotten upset”), death intrusion (five items, e.g. “In the past month, I have often dreamed about death-related things”), fear of death (four items, e.g. “In the past month, whenever thinking of death, I have often felt scared”) and avoidance of death (three items, e.g. “In the past month, I have often avoided thoughts or topics related to death”). Participants were asked to indicate their level of agreement using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The original version presented internal consistency values of $\alpha=0.86$ for the global scale and values of 0.80 for dysphoria, 0.78 for death intrusion, 0.77 for fear of death, and 0.57 for avoidance of death. In the current study, the alpha of the whole scale for Portuguese and Saudi Sample, respectively, were 0.89 and 0.94. Regarding dimensions, in the Portuguese sample: dysphoria $\alpha=0.87$, death intrusion $\alpha=0.80$, fear of death $\alpha=0.87$ and avoidance of death $\alpha=0.51$. In the Saudi sample: dysphoria $\alpha=0.90$, death intrusion $\alpha=0.83$, fear of death $\alpha=0.88$ and avoidance of death $\alpha=0.57$.

Sociodemographic data were also collected to characterise the samples, including information on age, gender, marital status and school qualifications.

Procedures

Collection procedure

Data were collected between April and June 2022. Upon approval of the Scientific Committee (entity responsible for monitoring the procedures and ethical safeguards of research) and assurance of ethical criteria (e.g., information about the voluntary and anonymous nature of the study).

The inclusion criteria for participation were the following: (i) age above 18 years and a university student and (ii) a voluntary willingness to participate. Informed consent was obtained, and the participants were asked to answer a self-report questionnaire with an average completion time of 8 min. Data collection was performed in university classes by one of the authors (always the same). The students received the questionnaire and after answering them, they put it into a box. No compensation was offered to participants, and the study subject was blinded.

Translation and adaptation procedures

The authors were asked to provide an English version of the scale, which was translated into Portuguese and Arabic through a translation and retranslation process, according to the procedures proposed by Hambleton et al. (2005). Two bilingual translators have supported the apparent validity through a back-translation procedure for the Portuguese and Arabic versions. The translations obtained were compared with the original version and adjusted to the final version by three expert psychologists on the subject. To test the translation and to determine possible misinterpretations, ambiguities or other semantics problems, 15 participants were asked to answer the Portuguese/Arabic version. This pretest shows a Cronbach alpha superior to 0.70 in both countries, and problems of interpretation were not detected. These participants were not included in the final samples. Items of the Portuguese and Arabic language versions of the SDA are presented in the Appendix.

Data analysis

The data was analysed using the SPSS 26.0 and Amos 24.0 programmes. To assess the factor structure of the SDA, confirmatory factor analysis (CFA) was performed using the maximum likelihood estimation method. Model fit was assessed using a comparative fit index (CFI), standardised root mean square residual (SRMR) and root mean square error of approximation (RMSEA). The cut-off values to determine whether the model was a good fit are $CFI \geq 0.90$, and ≤ 0.08 for SRMR and RMSEA (Browne & Cudeck, 1993; Byrne, 2016; Hu & Bentler, 1999).

Then, a multi-group confirmatory factor analysis (MGCFA) was used to test the measurement invariance of the SDA across cultural and gender groups. Three levels of invariance were tested sequentially: configural, metric and scalar invariance models (Cheung & Rensvold, 2002). Configural invariance implies that the factor structure is the same between comparison groups. Metric invariance implies equivalence of factor loadings for similar items between groups. Scalar invariance implies equivalence

of item intercepts across groups. Evidence for invariance is determined if $\Delta CFI \leq 0.01$, $\Delta RMSEA \leq 0.015$ and $\Delta SRMR \leq 0.03$ for tests of metric invariance, and $\Delta CFI \leq 0.01$, $\Delta RMSEA \leq 0.015$ and $\Delta SRMR \leq 0.01$ for tests of scalar invariance (Byrne & van de Vijver, 2010; Chen, 2007).

Finally, if scalar invariance was supported, comparisons of latent mean differences of the SDA across cultural and gender groups were conducted (Byrne et al., 1989). Latent mean analyses were performed to make the comparisons across groups, which depend on selecting one of the groups as a reference group for which the latent mean is fixed to zero. The value of the latent mean of the other group was freely estimated and represents the difference in the value of the latent mean between the two groups. In this study, Saudis and males served as the reference groups. Comparisons of latent means were made using the critical ratio (CR) index. A CR greater than or equal to 1.96 indicated statistical differences in means ($p < .05$). A positive CR value suggests that the latent mean value of the comparison group is higher than the reference group (Byrne, 2016).

Results

Analyses across cultures

Factorial validity of SDA

CFA was conducted to examine the four-factor structure of the SDA for each cultural group separately. The best-fitting models across the groups were the four-factor models with the following correlated errors: items 7 and 8, items 3 and 7, items 9 and 10, and items 11 and 16 for the Portuguese group; and items 7 and 8 for the Saudi group. Items with correlated errors were quite few in the Saudi group as well—only items 7 and 8, which both belong to the same dimension (death Intrusion) and come one after another on the questionnaire. Simultaneously, items with correlated residuals in the Portuguese group appear one after the other on the questionnaire (e.g., items 9 and 10), and they also belong to the same dimensions (e.g., items 16 and 11 belong to the fear of death dimension and they have the same meaning “was scared” and “felt afraid”). Research shows that error correlations decrease when items are randomly ordered while items with similar meaning often correlate (Bandalos, 2021). The models for Portuguese and Saudi groups obtained good fit indices as shown in Table 1. As shown in Table 2, all factor loadings of the items were significant and ranged from 0.26 to 0.84 in the Portuguese group and from 0.49 to 0.88 in the Saudi group.

Table 1 Fit indices of the SDA across cultures and gender groups

	χ^2 (df)	p	CFI	RMSEA (90% CI)	SRMR
Across cultures					
Portugal	281.6 (109)	0.000	0.908	0.086 (0.074–0.098)	0.0637
Saudi	299.8 (112)	0.000	0.952	0.067 (0.058–0.076)	0.0405
Across gender groups					
Males	265.5 (112)	0.000	0.928	0.086 (0.072–0.099)	0.0513
Females	298.0 (112)	0.000	0.958	0.064 (0.055–0.073)	0.0376

Note. *df*=degrees of freedom; CFI=comparative fit index; RMSEA=root mean square error of approximation; CI=confidence interval; SRMR=standardised root mean square residual

Table 2 Standardised factor loadings of items of the SDA across cultures and gender groups

Items	Across cultures		Across genders	
	Portugal	Saudi	Males	Females
Dysphoria				
Item 9	0.71	0.77	0.78	0.78
Item 10	0.66	0.69	0.75	0.72
Item 12	0.71	0.80	0.81	0.80
Item 14	0.82	0.88	0.89	0.88
Item 15	0.84	0.84	0.83	0.84
Death Intrusion				
Item 1	0.83	0.81	0.80	0.88
Item 3	0.73	0.75	0.75	0.80
Item 5	0.75	0.79	0.79	0.84
Item 7	0.57	0.52	0.54	0.60
Item 8	0.51	0.51	0.43	0.58
Fear of Death				
Item 11	0.63	0.77	0.83	0.74
Item 13	0.83	0.77	0.78	0.78
Item 16	0.84	0.86	0.90	0.86
Item 17	0.75	0.85	0.87	0.84
Avoidance of Death				
Item 2	0.26	0.49	0.38	0.31
Item 4	0.58	0.62	0.76	0.57
Item 6	0.73	0.57	0.71	0.62

Note. All factor loadings were significant at $p < .001$ except items 4 and 6 in the Portuguese sample, for which they were significant at $p < .05$

Measurement invariance

After verifying the factor structure of the SDA across the two cultures, the measurement invariance of the SDA was performed using MGCFA. The results shown in Table 3 indicate that the fit of the configural invariance model to the data was acceptable between Portugal and Saudi Arabia (CFI=0.938, SRMR=0.0405, RMSEA=0.053 [90% CI=0.047–0.058]), indicating that the four-factor structure of the SDA was equal across groups. The metric invariance model was also achieved (Δ CFI=0.005, Δ RMSEA=0.000, Δ SRMR=0.0027), but the scalar invariance model was not supported because Δ CFI exceeded the criterion value of 0.01 (Δ CFI=0.012, Δ RMSEA=0.003, Δ SRMR=0.0036). Partial scalar invariance was obtained after freeing the

intercept constraint on item 15 (In the past month, whenever thinking of death, I have often felt strange or alienated). Subsequently, the Δ CFI (Δ CFI=0.008) did not exceed the criterion value of 0.01, suggesting that the latent means of the remaining invariant 16 items could be compared across cultural groups.

Latent mean differences

The results showed that the Saudi participants scored higher than the Portuguese participants on dysphoria (Δ M = -0.939, SE=0.082, CR = -11.452, $p < .000$), death intrusion (Δ M = -1.248, SE=0.089, CR = -13.955, $p < .000$), fear of death (Δ M = -0.857, SE=0.095, CR = -9.004, $p < .000$) and avoidance of death (Δ M = -0.356, SE=0.084, CR = -4.232, $p < .000$).

Analyses across gender groups

Factorial validity of SDA

The factor structure of the SDA was examined across genders using the whole data, including Portuguese and Saudi participants. The four-factor model with the correlated error between item 7 and item 8 resulted in good fit indices for females and males. All factor loadings were significant and ranged from 0.31 to 0.88 in the female group and from 0.38 to 0.90 in the male group.

Measurement invariance

Table 3 shows the results of the measurement invariance of the SDA between females and males using the whole samples, including Portuguese and Saudi participants. The configural invariance model provided a good fit to the data, indicating that the factorial structure of SDA was equal across gender groups (CFI=0.948, SRMR=0.0513, RMSEA=0.051 [90% CI=0.045–0.056]). The results of the metric invariance test showed that all factor loadings were equivalent across groups (Δ CFI=0.000, Δ RMSEA=0.002, Δ SRMR=0.0022). The scalar invariance model was also obtained (Δ CFI=0.001, Δ RMSEA=0.001,

Table 3 Measurement invariance of the SDA across cultures and gender groups

Model	Overall fit indices				Comparative fit indices					
	χ^2 (df)	p	CFI	RMSEA (90% CI)	SRMR	$\Delta\chi^2$ (df)	p	Δ CFI	Δ RMSEA	Δ SRMR
Across cultures										
Configural	581.6 (221)	0.000	0.938	0.053 (0.047–0.058)	0.0405	45.0 (13)	0.000	0.005	0.000	0.0027
Metric	626.6 (234)	0.000	0.933	0.053 (0.048–0.058)	0.0432	83.3 (13)	0.000	0.012	0.003	0.0036
Scalar	709.9 (247)	0.000	0.921	0.056 (0.051–0.061)	0.0468	58.3 (12)	0.000	0.008	0.002	0.0004
Partial Scalar*	684.9 (246)	0.000	0.925	0.055 (0.050–0.060)	0.0472					
Across gender groups										
Configural	563.8 (224)	0.000	0.948	0.051 (0.045–0.056)	0.0513	16.3 (13)	0.233	0.000	0.002	0.0022
Metric	580.1 (237)	0.000	0.948	0.049 (0.044–0.055)	0.0535	14.2 (13)	0.359	0.001	0.001	0.0002
Scalar	594.3 (250)	0.000	0.947	0.048 (0.043–0.053)	0.0537					

Note. df = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardised root mean square residual. *intercept for item 15 was not constrained

Δ SRMR=0.0002), indicating that the latent means could be meaningfully compared between female and male participants.

Latent mean differences

Based on the establishment of the full measurement invariance across gender groups, the latent mean analyses were conducted using the whole data consisting of both national samples. The results indicate that females obtained higher scores than males on dysphoria (Δ M=0.432, SE=0.091, CR=4.736, $p < .000$), death intrusion (Δ M=0.282, SE=0.107, CR=2.634, $p = .008$) and fear of death (Δ M=0.579, SE=0.104, CR=5.565, $p < .000$). However, the two genders did not differ significantly on avoidance of death (Δ M = -0.083, SE = 0.051, CR = 1.633, $p = .102$).

In addition, two latent mean analyses were conducted for each country separately. The results show that the Portuguese females obtained higher scores on dysphoria (Δ M=0.223, SE=0.110, CR=2.027, $p = .047$) and fear of death than Portuguese males (Δ M=0.504, SE=0.116, CR=4.352, $p < .000$). However, the two genders did not differ significantly on death intrusion (Δ M=0.224, SE=0.126, CR=2.027, $p = .075$) and avoidance of death (Δ M=0.060, SE=0.072, CR=0.842, $p = .400$). In Saudi Arabia, Saudi females scored higher than Saudi males on dysphoria (Δ M=0.632, SE=0.119, CR=5.326, $p < .000$), death intrusion (Δ M=0.439, SE=0.129, CR=3.392, $p < .000$) and fear of death (Δ M=0.694, SE=0.134, CR=5.180, $p < .000$). However, the two genders did not differ significantly on avoidance of death (Δ M=0.138, SE=0.081, CR=1.706, $p = .088$).

Discussion and conclusion

This study aimed to adapt, validate and test the psychometric properties of the SDA in Portuguese and Arab samples, specifically to assess the factor structure of the SDA through CFA, to test the measurement invariance across cultural and gender groups and to compare the latent mean differences of the SDA across cultural and gender groups. The CFA showed a four-factor structure, like the original structure, maintaining the same dimensions in both cultures. Configural invariance was observed in both the Portuguese and the Arab samples, as well as between genders, which reveals that the same construct was measured between groups. The metric invariance was equally verified in both samples and between genders, implying that Portuguese and/or Arab women and men understand and interpret the items in a similar way. Regarding scalar invariance, this tests the equivalence of intercepts of items, and this implies that any

differences between groups in the means of the items are the result of true differences in the means of their corresponding construct. In this study, no scalar invariance was observed in all items regarding cross-cultural analysis. The partial scalar invariance was later tested, verifying that item 15 (In the past month, whenever thinking of death, I have often felt strange or alienated) showed evidence of variance between cultures. This variance may be associated not only with culture but also with the way people express their concern about death and a greater observance of religious rituals in Islamic cultures, expressed in religious police (e.g. Pietenpol et al., 2018). Across genders, scalar invariance was observed for all items.

Regarding the comparison of latent means across cultures, it was observed that Arabs have greater means of death anxiety. This result is in line with the referenced studies (e.g. Abdel-Khalek 2003, 2005; Morris & McAdie, 2009), which showed that Arab countries have higher levels of death anxiety than Western countries. This evidence can be explained in light of several variables, such as cultural values, religion and strength of religious and existential beliefs, namely regarding life after death. Portugal, typically Christian, and Arab countries, typically Islamic, share the same belief in life after death, and we can observe equal values in the strength of religious beliefs; however, while religiosity can alleviate death anxiety among the Portuguese, in Arabs it increases it. Some aspects may explain this difference. In Islam, religion is the basis and determines all social and political organisation; there is no separation of state and religion. People must observe the Qur'an and sharia, scrupulously comply with their norms and respect and practise Islamic virtues at the risk of being punished by law and not deserving of heaven (e.g. Elaskary & Yun, 2017). Arabs have a very strong belief in punishment, so if they haven't been good Muslims, the afterlife can be hell (e.g. Morris et al., 2009; IslamReligion.com, 2009). Their fear of death stems from the expectation of judgement and punishment (Rose & O'Sullivan, 2002) and therefore the need for more time to be "a good Muslim" and earn heaven. These are interpretations that deserve to be evaluated in future studies, namely considering the different branches of Islam (e.g. Sunnis, Shiites). Despite not being the objective of this study, and the studies not being consensual regarding the relationship between death anxiety and level of religiosity (e.g. Jong et al., 2018, 2021), we consider that the absence of a measure of the level of religiosity, intrinsic and extrinsic (e.g. Naeimi et al., 2022), and the belief in life after death may be a limitation of our study. This measure would help to support this possible explanation, which is why we suggest including it in future studies.

In relation to gender, as advanced by the literature, it is women who have higher levels of anxiety in the face of

death in both cultures. Women scored higher than men on three subscales of the SDA: dysphoria (somatic component of death anxiety, alluding to feelings such as tiredness, annoyance and emotional isolation when thinking about death), death intrusion (cognitive component of death anxiety, referring to intrusive nightmares, images and thoughts related to death itself) and fear of death (emotional component of death anxiety, referring to feelings of fear of death along with emotional and somatic symptoms). Several studies have reported significant gender differences in Arab countries (e.g. Abdel-Khalek 1986, 1991, 2005; Abdel-Khalek & Omar, 1988). For Pierce et al. (2007), gender differences in the experience of death anxiety are not straightforward. Templer (1986) states that the reason(s) for greater gender differences in death anxiety are not known but suggests that in countries where there are large differences in gender roles, men are expected to report less death anxiety than women. Some have conjectured that it may be due to women's tendency to view death in an emotionally charged way, while men's approach may be more cognitive (e.g., Krieger et al., 1974; Stillion, 1984). According to Saleem and Saleem (2020), gender is constructed through social and cultural institutions, so its analysis in death anxiety is relevant. Although the literature has established that women have greater death anxiety compared to men, there is still a need to investigate the cause of these differences (Saleem & Saleem, 2020). Thus, future studies should consider other factors to deepen these results (e.g., parenting, gender roles, professional activity, along with issues associated with religion and gender ideology). At the same time, other studies analysing the metric characteristics should also be considered in the future to assess other relevant validities, such as concurrent, discriminant and predictive validity, using the theory of terror management (Greenberg et al., 1997), identity to culture and life satisfaction and well-being, respectively.

Given that the study aims at adapting and validating an instrument, we highlight some limitations related to methodological strategies that can be reviewed in future investigations. We point out the sample size and its collection for convenience, which does not allow a generalization of the results to the populations under study (e.g. Sexton, 2022; Winton & Sabol 2022). Also noteworthy is the self-response method, which is susceptible to social desirability bias (Blair et al., 2020). When assessing personality with self-report measures, the underlying assumption is that individuals' responses are based on their self-assessment of how well the items' content describes them as a person. Thus, when researchers ask direct questions about opinions, actions, or beliefs, they may not receive truthful answers, due to social desirability bias or desire for privacy or malice. This is a particularly worrisome issue regarding questions

focused on sensitive behaviors or beliefs (Blair et al., 2020; Groves et al., 2011; Maccoby & Maccoby, 1954). To overcome the acquiescence and social desirability biases associated with self-report measures, namely those consisting of direct questions (e.g. Vésteinsdóttir et al., 2021; Weijters & Baumgartner, 2012), future studies should consider the approach of Edwards (1957) which advocates evaluating the convenience of the content of the items rather than the tendency of respondents to respond desirably. Future studies should also seek to compare the SDA with other existing instruments, as it will allow the assessment of concurrent and discriminant validity, contributing to the assessment of the metric quality and relevance of the SDA instrument.

In summary, this study has allowed us to investigate the properties of SDA in two different cultures and groups, thereby presenting itself as a reliable and valid measure in the study of death anxiety. It is an invariant instrument between cultures and between genders and presents itself as an asset in the assessment of death anxiety, as it includes a psychological, somatic and dysphoric aspect.

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Data Availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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